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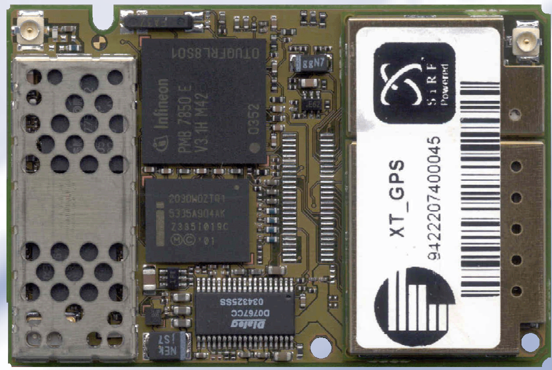

XT55

GPS Command Specification

Version: 04
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User's Guide

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New document: "XT55 GPS Command Specification" Version **04**

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Preceding document: "XT55 GPS Command Specification " Version 02
New document: "XT55 GPS Command Specification" Version 03

Chapter	Page	What is new
2nd cover page		Added new version of General Notes

Preceding document: "XT55 NMEA Input/Output Messages User's Guide" Version 01
New document: "XT55 GPS Command Specification" Version 02

Chapter	Page	What is new
---	---	Renamed document title from XT55 NMEA Input/Output Messages User's Guide to XT55 GPS Command Specification

1 NMEA Input/Output Messages

The SiRFstarIIe/LP Evaluation Receiver is capable of outputting data in the NMEA-0183 format as defined by the National Marine Electronics Association (NMEA), Standard for Interfacing Marine Electronic Devices, Version 2.20, January 1, 1997.

1.1 NMEA Output Messages

Table 1 lists each of the NMEA output messages supported by the SiRFstarIIe/LP Evaluation Receiver and a brief description.

Table 1: NMEA Output Messages

Option	Description
GGA	Time, position and fix type data.
GLL	Latitude, longitude, UTC time of position fix and status.
GSA	GPS receiver operating mode, satellites used in the position solution, and DOP values.
GSV	The number of GPS satellites in view satellite ID numbers, elevation, azimuth, and SNR values.
RMC	Time, date, position, course and speed data.
VTG	Course and speed information relative to the ground.
ZDA	PPS timing message (synchronized to PPS)
150	OK to send message

A full description and definition of the listed NMEA messages are provided by the next sections of this chapter.

1.1.1.1 GGA — Global Positioning System Fixed Data

Table 2 contains the values for the following example:

```
$GPGGA,161229.487,3723.2475,N,12158.3416,W,1,07,1.0,9.0,M, , ,
,0000*18
```

Table 2: GGA Data Format

Name	Example	Unit	Description
Message ID	$GPGGA		GGA protocol header
UTC Time	161229.487		hhmmss.sss
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N=north or S=south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E=east or W=west
Position Fix Indicator	1		See Table 3
Satellites Used	07		Range 0 to 12
HDOP	1.0		Horizontal Dilution of Precision
MSL Altitude[3]	9.0	m	
Unit	M	m	
Geoid Separation[1]		m	
Unit	M	m	
Age of Diff. Corr.		s	Null fields when DGPS is not used
Diff. Ref. Station ID	0000		
Checksum	*18		
<CR> <LF>			End of message termination

Table 3: Position Fix Indicator

Value	Description
0	Fix not available or invalid
1	GPS SPS Mode, fix valid
2	Differential GPS, SPS Mode, fix valid
3 - 5	Not supported
6	Dead reckoning mode, fix valid

Note: A valid position fix indicator is derived from the SiRF Binary M.I.D. 2 position mode 1. See Table 6

3 SiRF Technology Inc. does not support geoid corrections. Values are WGS84 ellipsoid heights.

1.1.2 GLL — Geographic Position - Latitude/Longitude

Table 4 contains the values for the following example:

```
$GPGLL,3723.2475,N,12158.3416,W,161229.487,A,*2C
```

Table 4: GLL Data Format

Name	Example	Unit	Description
Message ID	$GPGLL		GLL protocol header
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N = north or S = south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E = east or W = west
UTC Position	161229.487		hhmmss.sss
Status	A		A = data valid or V = data not valid
Checksum	*2C		
<CR> <LF>			End of message termination

1.1.2.1 GSA — GNSS DOP and Active Satellites

Table 5 contains the values for the following example:

```
$GPGSA,A,3,07,02,26,27,09,04,15, , , , , ,1.8,1.0,1.5*33
```

Table 5: GSA Data Format

Name	Example	Unit	Description
Message ID	$GPGSA		GSA protocol header
Mode 1	A		See Table 6
Mode 2	3		See Table 7
Satellite Used[3]	07		Sv on Channel 1
Satellite Used[3]	02		Sv on Channel 2
....			....
Satellite Used[3]			Sv on Channel 12
PDOP	1.8		Position Dilution of Precision
HDOP	1.0		Horizontal Dilution of Precision
VDOP	1.5		Vertical Dilution of Precision
Checksum	*33		
<CR> <LF>			End of message termination

3 Satellite used in solution.

Table 6: Mode 1

Value	Description
M	Manual - forced to operate in 2D or 3D mode
A	2DAutomatic - allowed to automatically switch 2D/3D

Table 7: Mode 2

Value	Description
1	Fix Not Available
2	2D (<4SV's used)
3	3D (>3SV's used)

1.1.3 GSV — GNSS Satellites in View

Table 8 contains the values for the following example:

```
$GPGSV,2,1,07,07,79,048,42,02,51,062,43,26,36,256,42,27,27,138,42*71
$GPGSV,2,2,07,09,23,313,42,04,19,159,41,15,12,041,42*41
```

Table 8: GSV Data Format

Name	Example	Unit	Description
Message ID	$GPGSV		GSV protocol header
Number of Messages[4]	2		Range 1 to 3
Message Number[4]	1		Range 1 to 3
Satellites in View	07		
Satellite ID	07		Channel 1 (Range 1 to 32)
Elevation	79	deg	Channel 1 (Maximum 90)
Azimuth	048	deg	Channel 1 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
....			....
Satellite ID	27		Channel 4 (Range 1 to 32)
Elevation	27	deg	Channel 4 (Maximum 90)
Azimuth	138	deg	Channel 4 (True, Range 0 to 359)
SNR (C/No)	42	dBHz	Range 0 to 99, null when not tracking
Checksum	*71		
<CR> <LF>			End of message termination

4 Depending on the number of satellites tracked multiple messages of GSV data may be required.

1.1.4 RMC — Recommended Minimum Specific GNSS Data

Table 10 contains the values for the following example:

```
$GPRMC,161229.487,A,3723.2475,N,12158.3416,W,0.13,309.62,120598, ,*10
```

Table 9: RMC Data Format

Name	Example	Unit	Description
Message ID	$GPRMC		RMC protocol header
UTC Time	161229.487		hhmmss.sss
Status[5]	A		A = data valid or V=data not valid
Latitude	3723.2475		ddmm.mmmm
N/S Indicator	N		N = north or S = south
Longitude	12158.3416		dddmm.mmmm
E/W Indicator	W		E = east or W = west
Speed Over Ground	0.13	knots	
Course Over Ground	309.62	deg	True
Date	120598		ddmmyy
Magnetic Variation[6]		deg	E = east or W = west
Checksum	*10		
<CR> <LF>			End of message termination

1.1.5 VTG — Course Over Ground and Ground Speed

Table 11 contains the values for the following example:

```
$GPVTG,309.62,T,,M,0.13,N,0.2,K,A*23
```

Table 10: VTG Data Format

Name	Example	Unit	Description
Message ID	$GPVTG		VTG protocol header
Course	309.62	deg	Measured heading
Reference	T		True
Course		deg	Measured heading
Reference	M		Magnetic[7]
Speed	0.13	knots	Measured horizontal speed
Units	N		Knots
Speed	0.2	km/h	Measured horizontal speed
Units	K		Kilometers per hour
Checksum	*23		
<CR> <LF>			End of message termination

5 A valid status is derived from the SiRF Binary M.I.D 2 position mode 1. See “ Table 71: Mode 1” on page -50.

6 SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

7 SiRF Technology Inc. does not support magnetic declination. All “course over ground” data are geodetic WGS84 directions.

1.1.6 ZDA – SiRF Timing Message

Outputs the time associated with the current 1 PPS pulse. Each message will be output within a few hundred ms after the 1 PPS pulse is output and will tell the time of the pulse that just occurred. Outputs will be only given if a position fix is valid.

Table 11 contains the values for the following example:

```
$GPZDA,181813,14,10,2003,00,00*4F
```

Table 11: ZDA Data Format

Name	Example	Unit	Description
Message ID	$GPZDA		ZDA protocol header
UTC Time	181813		Either using valid IONO/UTC or estimated from default leap seconds
Day	14		01 to 31
Month	10		01 to 12
Year	2003		1980 to 2079
Local zone hour	00	knots	Offset from UTC (set to 00)
Local zone minutes	00		Offset from UTC (set to 00)
Checksum			
<CR> <LF>			End of message termination

Note: **The ZDA NMEA message can only be polled or scheduled using the MSK NMEA input message. See Chapter 1.2.7**

1.1.7 150 – OkToSend

This message is being sent out during the trickle power mode to communicate with outside program such as SiRFDemo to indicate whether the receiver is awake or not. The output of this message can be enabled with $PSRF113, see Chapter 1.2.8 and 1.2.9.

Table 12 contains the values for the following example:

1. OkToSend
$PSRF150,1*3F
2. not OkToSend
$PSRF150,0*3E

Table 12: OkToSend Message Data Format

Name	Example	Unit	Description
Message ID	$PSRF150		$PSRF150 protocol header
OkToSend	1		1 = OK to send, 0 = not OK to send
Checksum	*3F		
<CR> <LF>			End of message termination

1.2 NMEA Input Messages

NMEA input messages are provided to allow you to control the Evaluation Receiver while in NMEA protocol mode. The Evaluation Receiver may be put into NMEA mode by sending the SiRF Binary protocol message (see Chapter 2.1.3) using a user program or using the SiRFdemo software and selecting Switch to NMEA Protocol from the Action menu. If the receiver is in SiRF Binary mode, all NMEA input messages are ignored. Once the receiver is put into NMEA mode, the following messages may be used to command the module.

Table 13: Transport Message

Start Sequence	Payload	Checksum	End Sequence
$PSRF<MID>[8]	Data[9]	*CKSUM[10]	<CR> <LF>[11]

Note: All fields in all proprietary NMEA messages are required, none are optional. All NMEA messages are comma delimited.

Table 14: NMEA Input Messages

Message	MID[12]	Description
SetSerialPort	100	Set PORT A parameters and protocol
NavigationInitialization	101	Parameters required for start using X/Y/Z[13]
SetDGPSPort	102	Set PORT B parameters for DGPS input
Query/Rate Control	103	Query standard NMEA message and/or set output rate
LLANavigationInitialization	104	Parameters required for start using Lat/Lon/Alt[14]
Development Data On/Off	105	Development Data messages On/Off
MSK Receiver Interface	MSK	Command message to a MSK radio-beacon receiver.

Note: NMEA input messages 100 to 105 are SiRF proprietary NMEA messages. The MSK NMEA string is as defined by the NMEA 0183 standard.

8 Message Identifier consisting of three numeric characters. Input messages begin at MID 100.

9 Message specific data. Refer to a specific message section for <data>...<data> definition.

10 CKSUM is a two-hex character checksum as defined in the NMEA specification. Use of checksums is required on all input messages.

11 Each message is terminated using Carriage Return (CR) Line Feed (LF) which is \r\n which is hex 0D 0A. Because \r\n are not printable ASCII characters, they are omitted from the example strings, but must be sent to terminate the message and cause the receiver to process that input message.

12 Message Identification (MID).

13 Input coordinates must be WGS84.

14 Input coordinates must be WGS84.

1.2.1 100 — SetSerialPort

This command message is used to set the protocol (SiRF Binary or NMEA) and/or the communication parameters (baud, data bits, stop bits, parity). Generally, this command is used to switch the module back to SiRF Binary protocol mode where a more extensive command message set is available. When a valid message is received, the parameters are stored in battery backed SRAM and then the Evaluation Receiver restarts using the saved parameters.
Table 15 contains the input values for the following example:

```
Switch to SiRF Binary protocol at 9600,8,N,1
$PSRF100,0,9600,8,1,0*0C
```

Table 15: Set Serial Port Data Format

Name	Example	Unit	Description
Message ID	$PSRF100		PSRF100 protocol header
Protocol	0		0 = SiRF Binary, 1 = NMEA
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7[15]
StopBits	1		0,1
Parity	0		0 = None, 1 = Odd, 2 = Even
Checksum	*0C		
<CR> <LF>			End of message termination

1.2.2 101 — NavigationInitialization

This command is used to initialize the Evaluation Receiver by providing current position (in X, Y, Z coordinates), clock offset, and time. This enables the Evaluation Receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the Evaluation Receiver to acquire signals quickly.

Table 16 contains the input values for the following example:

```
Start using known position and time.
$PSRF101,-2686700,-4304200,3851624,96000,497260,921,12,3*1C
```

Table 16: Navigation Initialization Data Format

Name	Example	Unit	Description
Message ID	$PSRF101		PSRF101 protocol header
ECEF X	-2686700	m	X coordinate position
ECEF Y	-4304200	m	Y coordinate position
ECEF Z	3851624	m	Z coordinate position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Receiver[16]

15 SiRF protocol is only valid for 8 data bits, 1stop bit, and no parity.

16 Use 0 for last saved value if available.If this is unavailable, a default value of 96,000 will be used.

Name	Example	Unit	Description
TimeOfWeek	497260	s	GPS Time Of Week
WeekNo	921		GPS Week Number
ChannelCount	12		Range 1 to 12
ResetCfg	3		See Table 17
Checksum	*1C		
<CR> <LF>			End of message termination

Table 17: Reset Configuration

Hex	Description
0x01	Hot Start - All data valid
0x02	Warm Start – Ephemeris cleared
0x03	Warm Start (with Init) - Ephemeris cleared, initialization data loaded
0x04	Cold Start - Clears all data in memory
0x08	Clear Memory - Clears all data in memory and resets receiver back to factory defaults

1.2.3 102 — SetDGPSPort

This command is used to control the serial port used to receive RTCM differential corrections. Differential receivers may output corrections using different communication parameters. If a DGPS receiver is used which has different communication parameters, use this command to allow the receiver to correctly decode the data. When a valid message is received, the parameters are stored in battery backed SRAM and then the receiver restarts using the saved parameters.
Table 18 contains the input values for the following example:

```
Set DGPS Port to be 9600,8,N,1.
$PSRF102,9600,8,1,0*12
```

Table 18: Set DGPS Port Data Format

Name	Example	Unit	Description
Message ID	$PSRF102		PSRF102 protocol header
Baud	9600		4800, 9600, 19200, 38400
DataBits	8		8,7
StopBits	1		0,1
Parity	0		0 = None, 1 = Odd, 2 = Even
Checksum	*12		
<CR> <LF>			End of message termination

1.2.4 103 — Query/Rate Control

This command is used to control the output of standard NMEA messages GGA, GLL, GSA, GSV, RMC, and VTG. Using this command message, standard NMEA messages may be polled once, or set-up for periodic output. Checksums may also be enabled or disabled depending on the needs of the receiving program. NMEA message settings are saved in battery backed memory for each entry when the message is accepted.

Table 19 contains the input values for the following examples:

1. Query the GGA message with checksum enabled
   `$PSRF103,00,01,00,01*25`
2. Enable VTG message for a 1 Hz constant output with checksum enabled
   `$PSRF103,05,00,01,01*20`
3. Disable VTG message
   `$PSRF103,05,00,00,01*21`

Table 19: Query/Rate Control Data Format (See example 1)

Name	Example	Unit	Description
Message ID	$PSRF103		PSRF103 protocol header
Msg	00		See table 17
Mode	01		0 = SetRate, 1 = Query
Rate	00	s	Outputof f= 0, max = 255
CksumEnable	01		0 = Disable Checksum, 1 = Enable Checksum
Checksum	*25		
<CR> <LF>			End of message termination

Table 20: Messages

Value	Description
0	GGA
1	GLL
2	GSA
3	GSV
4	RMC
5	VTG
6	No defined
07	ZDA (if 1 PPS output is supported)
9	Not defined

Note: In Trickle Power mode, update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the Trickle Power Update rate and the NMEA update rate (i.e., Trickle Power update rate = 2s, NMEA update rate = 5s, resulting update rate is every 10 seconds, (2 X 5s = 10s)).

1.2.5 104 — LLANavigationInitialization

This command is used to initialize the Evaluation Receiver by providing current position (in latitude, longitude, and altitude coordinates), clock offset, and time. This enables the receiver to search for the correct satellite signals at the correct signal parameters. Correct initialization parameters enable the receiver to acquire signals quickly.

Table 21 contains the input values for the following example:

```
Start using known position and time.
$PSRF104,37.3875111,-121.97232,0,96000,237759,1946,12,1*07
```

Table 21: LLA Navigation Initialization Data Format

Name	Example	Unit	Description
Message ID	$PSRF104		PSRF104 protocol header
Lat	37.3875111	deg	Latitude position (Range 90 to -90)
Lon	-121.97232	deg	Longitude position (Range 180 to -180)
Alt	0	m	Altitude position
ClkOffset	96000	Hz	Clock Offset of the Evaluation Receiver[17]
TimeOfWeek	237759	s	GPS Time Of Week
WeekNo	1946		Extended GPS Week Number (1024 added)
ChannelCount	12		Range 1 to 12
ResetCfg	1		See table 19
Checksum	*07		
<CR> <LF>			End of message termination

Table 22: Reset Configuration

Hex	Description
0x01	Hot Start - All data valid
0x02	Warm Start - Ephemeris cleared
0x03	Warm Start (with Init) - Ephemeris cleared, initialization data loaded
0x04	Cold Start - Clears all data in memory
0x08	Clear Memory - Clears all data in memory and resets receiver back to factory defaults

17 Use 0 for last saved value if available. If this is unavailable, a default value of 96,000 will be used.

1.2.6 105 — Development Data On/Off

Use this command to enable development data information if you are having trouble getting commands accepted. Invalid commands generate debug information that enables the user to determine the source of the command rejection. Common reasons for input command rejection are invalid checksum or parameter out of specified range.
Table 23 contains the input values for the following examples:

1. Debug On
   `$PSRF105,1*3E`
2. Debug Off
   `$PSRF105,0*3F`

Table 23: Development Data On/Off Data Format

Name	Example	Unit	Description
Message ID	$PSRF105		PSRF105 protocol header
Debug	1		0 = Off, 1 = On
Checksum	*3E		
<CR> <LF>			End of message termination

1.2.7 113 - Disable Power Saving

Table 24: Disable power saving

Name	Example	Unit	Description
Message ID	$PSRF113		PSRF113 protocol header
Mode	0		0 = switch off power saving
Checksum	*38		
<CR> <LF>			End of message termination

1.2.8 113 - Enable Trickle Power mode

Table 25: Enable trickle Power mode

Name	Example	Unit	Description
Message ID	$PSRF113		PSRF113 protocol header
Mode	1		1 = Enable Trickle Power mode
On Time	200	ms	
Interval	1000	ms	Duty cycle of 20%
MaxOffTime	30000	ms	If no satellites are in view, the GPS receiver enters sleep mode for approx. 30s
MaxAcqTime	60000	ms	If the GPS receiver is in Trickle Power mode and fails to acquire satellite data, the receiver enters acquisition mode for approx. 60s
TPAdaptive	0		0 = switch off Adaptive mode
Checksum	*13		
<CR> <LF>			End of message termination

1.2.9 113 - Enable Push-to-Fix mode

Table 26: Enable Push-to-Fix mode

Name	Example	Unit	Description
Message ID	$PSRF113		PSRF113 protocol header
Mode	2		
Fixtime	100000	ms	The receiver remains in sleep mode for approx. 100ms. After that, the receiver starts a position fix.
Checksum	*17		
<CR> <LF>			End of message termination

1.2.10 MSK — MSK Receiver Interface

Table 27 contains the values for the following example:

```
$GPMSK,318.0,A,100,M,2,*45
```

Table 27: RMC Data Format

Name	Example	Unit	Description
Message ID	$GPMSK		MSK protocol header
Beacon Frequency	318.0	kHz	Frequency to use
Auto/Manual Frequency[18]	A		A: Auto, M: Manual
Beacon Bit Rate	100		Bits per second
Auto/Manual Bit Rate[18]	M		A: Auto, M: Manual

Note: The NMEA messages supported by the Evaluation Receiver does not provide the ability to change the DGPS source. If you need to change the DGPS source to internal beacon, then this must be done using the SiRF Binary protocol and then switched to NMEA.

18 If Auto is specified the previous field value is ignored.

2 The SiRF Binary Protocol

The SiRF Binary protocol is the standard interface protocol used by the SiRFstarIIe/LP Evaluation Receiver and other SiRF products.

This serial communication protocol is designed to include:

- Reliable transport of messages
- Ease of implementation
- Efficient implementation
- Independence from payload

Protocol Layers

Table 28: Transport Message

Start Sequence	Payload Length	Payload	Message Checksum	End Sequence
0xA0[19], 0xA2	Two-bytes (15-bits)	Up to 2^{10} -1 (<1023)	Two-bytes (15-bits)	0xB0, 0xB3

Transport

The transport layer of the protocol encapsulates a GPS message in two start characters and two stop characters. The values are chosen to be easily identifiable and unlikely to occur frequently in the data. In addition, the transport layer prefixes the message with a two-byte (15-bit) message length and a two-byte (15-bit) checksum. The values of the start and stop characters and the choice of a 15-bit value for length and checksum ensure message length and checksum can not alias with either the stop or start code.

Message Validation

The validation layer is of part of the transport, but operates independently. The byte count refers to the payload byte length. The checksum is a sum on the payload.

Payload Length

The payload length is transmitted high order byte first followed by the low byte.

High Byte	Low Byte
< 0x7F	Any value

Even though the protocol has a maximum length of (2^{15}-1) bytes, practical considerations require the SiRF GPS module implementation to limit this value to a smaller number. The SiRF receiving programs (e.g., SiRFdemo) may limit the actual size to something less than this maximum.

Payload Data

The payload data follows the payload length. It contains the number of bytes specified by the payload length. The payload data may contain any 8-bit value.

Where multi-byte values are in the payload data neither the alignment nor the byte order are defined as part of the transport although SiRF payloads will use the big- endian order.

19 0xYY denotes a hexadecimal byte value. 0xA0 equals 160.

Checksum

The checksum is transmitted high order byte first followed by the low byte. This is the so-called big-endian order.

High Byte	Low Byte
< 0x7F	Any value

The checksum is 15-bit checksum of the bytes in the payload data. The following pseudo code defines the algorithm used.

Let message to be the array of bytes to be sent by the transport.

```
Let msgLen be the number of bytes in the message array to be
transmitted.
Index = first
checkSum = 0
while index < msgLen
checkSum = checkSum + message[index]
checkSum = checkSum AND (2^15-1).
```

2.1 Input Messages for SiRF Binary Protocol

Table 29 lists the message list for the SiRF input messages.

Table 29: SiRF Messages - Input Message List

Hex	ASCII	Name	Description
0x80	128	Initialize Data Source	Receiver initialization and associated parameters
0x81	129	Switch to NMEA Protocol	Enable NMEA messages, output rate and baud rate
0x82	130	Set Almanac (upload)	Sends an existing almanac file to the receiver
0x84	132	Poll Software Version	Polls for the loaded software version
0x85	133	DGPS Source Control	DGPS correction source and beacon receiver information
0x86	134	Set Main Serial Port	Baud rate, data bits, stop bits, and parity
0x87	135	Switch Protocol	Obsolete
0x88	136	Mode Control	Navigation mode configuration
0x89	137	DOP Mask Control	DOP mask selection and parameters
0x8A	138	DGPS Mode	DGPS mode selection and timeout value
0x8B	139	Elevation Mask	Elevation tracking and navigation masks
0x8C	140	Power Mask	Power tracking and navigation masks
0x8D	141	Editing Residual	Not implemented
0x8E	142	Steady-State Detection - Not Used	Not implemented
0x8F	143	Static Navigation	Configuration for static operation
0x90	144	Poll Clock Status	Polls the clock status
0x91	145	Set DGPS Serial Port	DGPS port baud rate, data bits, stop bits, and parity
0x92	146	Poll Almanac	Polls for almanac data
0x93	147	Poll Ephemeris	Polls for ephemeris data
0x94	148	Flash Update	On the fly software update
0x95	149	Set Ephemeris (upload)	Sends an existing ephemeris to the receiver
0x96	150	Switch Operating Mode	Test mode selection, SV ID, and period.
0x97	151	Set TricklePower Parameters	Push to fix mode, duty cycle, and on time
0x98	152	Poll Navigation Parameters	Polls for the current navigation parameters
0xA5	165	Set UART Configuration	Protocol selection, baud rate, data bits, stop bits, and parity
0xA6	166	Set Message Rate	SiRF Binary message output rate
0xA7	167	Low Power Acquisition Parameters	Low power configuration parameters
0xA8	168	Poll Command Parameters	Poll for parameters: 0x80: Receiver initialization and associated parameters.

Hex	ASCII	Name	Description
			0x85: DGPS correction source and beacon receiver information 0x88: Navigation mode configuration 0x89: DOP mask selection and parameters 0x8A: DGPS mode selection and timeout values 0x8B: Elevation tracking and navigation masks 0x8C: Power tracking and navigation masks 0x8F: Static navigation configuration 0x97: Low power parameters
0xAA	170	Set SBAS Parameters	SBAS configuration parameters
0xB6	182	Set UART Configuration	Obsolete

2.1.1 Transmit Serial Message - Message I.D. 85

Message I.D. 85 is a user configurable SiRF Binary string with variable payload and variable payload length.

Example:

```
A0A2xxxx — Start Sequence and Payload Length
xxxxxxxx...... — Payload
xxxxB0B3 — Message Checksum and End Sequence
```

Table 30: Initialize Data Source

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		55		Decimal 85
User defined	Variable				User defined

Payload Length: variable length

2.1.2 Initialize Data Source - Message I.D. 128

Table 31 contains the input values for the following example:
Warm start the receiver with the following initialization data:

```
ECEF XYZ
(-2686727 m, -4304282 m, 3851642 m), Clock Offset (75,000 Hz), Time of
Week (86,400 s), Week Number (924), and Channels (12). Raw track data
enabled, Debug data enabled.
```

Example:

```
A0A20019 — Start Sequence and Payload Length
80FFD700F9FFBE5266003AC57A000124F80083D600039C0C33 — Payload
0A91B0B3 — Message Checksum and End Sequence
```

Table 31: Initialize Data Source

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		80		ASCII 128
ECEF X	4		FFD700F	m	
ECEF Y	4		FFBE5266	m	
ECEF Z	4		003AC57A	m	
Clock Offset	4		000124F8	Hz	
Time of Week	4	*100	0083D600	s	
Week Number	2		039C		
Channels	1		0C		Range 1-12
Reset Config.	1		33		See Table 25

Payload Length: 25 bytes

Table 32: Reset Configuration Bitmap

Bit	Description
0	Data valid flag – 1 = Use data in ECEF X, Y, Z, Clock Offset, Time of week and week number to initialize the receiver 0 = Ignore data fields
1	Clear ephemeris from memory -- blocks snap or hot start from occurring
2	Clear all history (except clock drift) from memory – blocks snap, hot and warm starts
3	Factory Reset
4	Enable raw track data (YES = 1, NO = 0)
5	Enable debug data for SiRF binary protocol (YES = 1, NO = 0)
6	Enable debug data for NMEA protocol (YES = 1, NO = 0)
7	Reserved (must be 0)

Note: If Nav Lib data is ENABLED then the resulting messages are enabled. Clock Status (MID 7), 50 BPS (MID 8), Raw DGPS (17), NL Measurement Data (MID 28), DGPS Data (MID 29), SV State Data (MID 30), and NL Initialize Data (MID 31). All messages are sent at 1Hz. If SiRFdemo is used to enable Nav Lib data, the baud rate will be automatically set to 57600 by SiRFdemo.

2.1.3 Switch To NMEA Protocol - Message I.D. 129

Table 33 contains the input values for the following example:

Request the following NMEA data at 9600 baud:
GGA – ON at 1 sec, GLL – OFF, GSA - ON at 1sec,
GSV – ON at 5 sec, RMC – ON at 1sec, VTG-OFF

Example:

A0A20018 – Start Sequence and Payload Length
81 02 01 01 00 01 01 01 05 01 01 01 00 01 00 01 00 01 00 01 00 01 25 80 — Payload
01 3A B0 B3—Message Checksum and End Sequence

Table 33: Switch To NMEA Protocol

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		81		Decimal 129
Mode	1		02		
GGA Message[20]	1		01	s	Refer to www.sirf.com for details.
Checksum[21]	1		01		
GLL Message	1		00	s	Refer to www.sirf.com for details.
Checksum	1		01		
GSA Message	1		05	s	Refer to www.sirf.com for details.
Checksum	1		01		
GSV Message	1		05	s	Refer to www.sirf.com for details.
Checksum	1		01		
RMC Message	1		00	s	Refer to www.sirf.com for details.
Checksum:	1		01		
VTG Message	1		00	s	Refer to www.sirf.com for details.
Checksum	1		01		
Unused Field	1		01		
ZDA Message	1		01	s	Refer to www.sirf.com for details.
Unused Field	1		01		
Unused Field	1		00		
Unused Field	1		01		
Unused Field	1		00		
Baud Rate	2		25 80		38400, 19200, 9600, 4800, 2400

Payload Length: 24 bytes

20 A value of 0x00 implies NOT to send message, otherwise data is sent at 1 message every X seconds requested (i.e., to request a message to be sent every 5 seconds, request the message using a value of 0x05.) Maximum rate is 1/255s.

21 A value of 0x00 implies the checksum NOT transmitted with the message (not recommended). A value of 0x01 will have a checksum calculated and transmitted as part of the message (recommended).

Table 34: Mode values

Value	Meaning
0	Enable NMEA debug messages
1	Disable NMEA debug messages
2	Do not change last-set value for NMEA debug messages

In Trickle Power mode, update rate is specified by the user. When you switch to NMEA protocol, message update rate is also required. The resulting update rate is the product of the Trickle Power Update rate and the NMEA update rate (i.e. Trickle Power update rate = 2s, NMEA update rate = 5 seconds, resulting update rate is every 10 seconds, (2 X 5 = 10)).

Note: To switch back to the SiRF protocol, you must send a SiRF NMEA message to revert to SiRF Binary mode.

2.1.4 Set Almanac – Message I.D. 130

This command enables the user to upload an almanac file to the Evaluation Receiver.

Example:

```
A0A20380 - Start Sequence and Payload Length
82xx…………………. 	- Payload
xxxxB0B3 - Message Checksum and End Sequence
```

Table 35: Set Almanac Message

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		82		ACSII 130
Almanac	896		00		Reserved

Payload Length: 897 bytes

The almanac data is stored in the code as a 448 element array of INT16 values. These 448 elements are partitioned as 32 x 14 elements where the 32 represents the satellite number minus 1 and the 14 represents the number of INT16 values associated with this satellite. The data is actually packed and the exact format of this representation and packing method can be extracted from the ICD-GPS-2000 document. The ICD-GPS- 2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps

2.1.5 Poll Software Version – Message I.D. 132

Table 36 contains the input values for the following example:

```
Poll the software version
```

Example:

```
A0A20002 — Start Sequence and Payload Length
8400 — Payload
0084B0B3 — Message Checksum and End Sequence
```

Table 36: Software Version

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		84		ACSII 132
Control	1		00		Not used

Payload Length: 2 bytes

2.1.6 DGPS Source - Message I.D. 133

This command allows the user to select the source for DGPS corrections. Options available are:

```
External RTCM Data (any serial port)
WAAS (subject to WAAS satellite availability)
Internal DGPS beacon receiver
```

Example 1: Set the DGPS source to External RTCM Data

```
A0A200007 — Start Sequence and Payload Length
85020000000000 — Payload
0087B0B3 — Checksum and End Sequence
```

Table 37: DGPS Source Selection (Example 1)

Name	Bytes	Scale	Hex	Unit	Decimal	Description
Message I.D.	1		85		133	Message Identification
DGPS Source	1		00		0	See Table 36. DGPS Source Selections
Internal Beacon Frequency	4		00000000	Hz	0	Internal Beacon Search Settings
Internal Beacon Bit Rate	1		0	bps	0	Internal Beacon Search Settings

Payload Length: 7 bytes

Example 2: Set the DGPS source to Internal DGPS Beacon Receiver

```
Search Frequency 310000, Bit Rate 200
A0A200007 — Start Sequence and Payload Length
85030004BAF0C802 — Payload
02FEB0B3 — Checksum and End Sequence
```

Table 38: DGPS Source Selection (Example 2)

Name	Bytes	Scale	Hex	Unit	Decimal	Description
Message I.D.	1		85		133	Message Identification.
DGPS Source	1		03		3	See Table 36. DGPS Source Selections.
Internal Beacon Frequency	4		0004B AF0	Hz	310000	See Table 37. Internal Beacon Search Settings.
Internal Beacon Bit Rate	1		C8	bps	200	See Table 37. Internal Beacon Search Settings.

Payload Length: 7 bytes

Table 39: DGPS Source Selections

DGPS Source	Hex	Decimal	Description
None	00	0	DGPS corrections are not used (even if available).
WAAS	01	1	Uses WAAS Satellite (subject to availability).
External RTCM Data	02	2	External RTCM input source (i.e., Coast Guard Beacon).
Internal DGPS Beacon Receiver	03	3	Internal DGPS beacon receiver.
User Software	04	4	Corrections provided using a module interface routine in a custom user application.

Table 40: Internal Beacon Search Settings

Search Type	Frequency[22]	Bit Rate[23]	Description
Auto Scan	0	0	Auto scanning of all frequencies and bit rates are performed.
Full Frequency scan	0	None zero	Auto scanning of all frequencies and specified bit rate are performed.
Full Bit Rate Scan	None Zero	0	Auto scanning of all bit rates and specified frequency are performed.
Specific Search	Non Zero	Non zero	Only the specified frequency and bit rate search are performed.

2.1.7 Set Main Serial Port - Message I.D. 134

Table 41 contains the input values for the following example:

```
Set Main Serial port to 9600,n,8,1.
```

Example:

```
A0A20009 — Start Sequence and Payload Length
860000258008010000 — Payload
0134B0B3 — Message Checksum and End Sequence
```

Table 41: Set Main Serial Port

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		86		decimal 134
Baud	4		00002580		38400,19200,9600,4800,2400,1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None = 0, Odd = 1, Even = 2
Pad	1		00		Reserved

Payload Length: 9 bytes

22 Frequency Range is 283500 to 325000 Hz.

23 Bit Rate selection is 25, 50, 100 and 200 BPS.

2.1.8 Switch Protocol - Message I.D. 135

This message is obsolete and is no longer used or supported.

2.1.9 Mode Control - Message I.D. 136

Table 42 contains the input values for the following example:

```
3D Mode = Always, Alt Constraining = Yes, Degraded Mode = clock then
direction, TBD=1, DR Mode = Yes, Altitude = 0, Alt Hold Mode = Auto,
Alt Source =Last Computed, Coast Time Out = 20, Degraded Time Out=5,
DR Time Out = 2, Track Smoothing = Yes
```

Example:

```
A0A2000E — Start Sequence and Payload Length
88010101010100000002140501 — Payload
00A9B0B3 — Message Checksum and End Sequence
```

Table 42: Mode Control

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		88		Decimal 136
TBD	2		00 00		Reserved
Degraded Mode	1		01		See Table 40
TBD	1		01		Reserved
Altitude	2		0000	m	User specified altitude, Range: -1,000 to 10,000
Alt Hold Mode	1		00		See Table 43
Alt Hold Source	1		02		0 = Use last computed altitude 1 = Use user-input altitude
TBD					Reserved
Degraded Time Out	1		05	s	0 = disable degraded mode, 1 - 120 seconds degraded mode time limit[1]
DR Time Out	1		01	s	0 = disable dead reckoning, 1 - 120 seconds dead reckoning mode time limit[2]
Track Smoothing	1		01		0 = disable, 1 = enable

Payload Length: 14 bytes

Table 43: Degraded Mode Byte Value

Byte Value	Description
0	Allow 1 SV navigation, freeze direction for 2 SV fix, then freeze clock drift for 1 SV fix
1	Allow 1 SV navigation, freeze clock drift for 2 SV fix, then freeze direction for 1 SV fix
2	Allow 2 SV navigation, freeze direction
3	Allow 2 SV navigation, freeze clock drift
4	Do not allow degraded modes (2 SV and 1 SV navigation)

Table 44: Altitude Hold Mode

Byte Value	Description
0	Automatically determine best available altitude to use
1	Always use input altitude
2	Do not use altitude hold

2.1.10 DOP Mask Control - Message I.D. 137

Table 45 contains the input values for the following example:

```
Auto Pdop/Hdop, Gdop =8 (default), Pdop=8,Hdop=8
```

Example:

```
A0A20005 — Start Sequence and Payload Length
8900080808 — Payload
00A1B0B3 — Message Checksum and End Sequence
```

Table 45: DOP Mask Control

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		89		ASCII 137
DOP Selection	1		00		See Table 42
GDOP Value	1		08		Range 1 to 50
PDOP Value	1		08		Range 1 to 50
HDOP Value	1		08		Range 1 to 50

Payload Length: 5 bytes

Table 46: DOP Selection

Byte Value	Description
0	Auto PDOP/HDOP
1	PDOP
2	HDOP
3	GDOP
4	Do not use

2.1.11 DGPS Control - Message I.D. 138

Table 47 contains the input values for the following example:

```
Set DGPS to exclusive with a time out of 30 seconds.
```

Example:

```
A0A20003 — Start Sequence and Payload Length
8A011E — Payload
00A9B0B3 — Message Checksum and End Sequence
```

Table 47: DGPS Control

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		8A		ASCII 138
DGPS Selection	1		01		See Table 45
DGPS Time Out:	1		1E	s	Range 0 to 255

Payload Length: 3 bytes

Table 48: DGPS Selection

Byte Value	Description
0	Auto
1	Exclusive
2	Never use

Note: DGPS Timeout interpretation varies with DGPS correction source. For internal beacon receiver or RTCM SC-104 external source, a value of 0 means infinite timeout (use corrections until another one is used). A value of 1 - 255 means use the corrections for a maximum of this many seconds. For DGPS corrections from an SBAS source, the timeout value is ignored unless Message ID 170, Flag bit 0 is set to 1 (User Timeout). If MID 170 specifies User Timeout, a value of 1 to 255 here means that SBAS corrections may be used for the number of seconds specified. A value of 0 means to use the timeout specified by the SBAS satellite (usually 18 seconds).

2.1.12 Elevation Mask – Message I.D. 139

Table 49 contains the input values for the following example:

```
Set Navigation Mask to 15.5 degrees (Tracking Mask is defaulted to 5
degrees).
```

Example:

```
A0A20005 — Start Sequence and Payload Length
8B0032009B — Payload
0158B0B3 — Message Checksum and End Sequence
```

Table 49: Elevation Mask

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		8B		ASCII 139
Tracking Mask	2	*10	0032	deg	Not implemented
Navigation Mask	2	*10	009B	deg	Range -20.0 to 90.0

Payload Length: 5 bytes

2.1.13 Power Mask - Message I.D. 140

Table 50 contains the input values for the following example:

```
Navigation mask to 33 dBHz (tracking default value of 28)
```

Example:

```
A0A20003 — Start Sequence and Payload Length
8C1C21 — Payload
00C9B0B3 — Message Checksum and End Sequence
```

Table 50: Power Mask

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		8C		ASCII 140
Tracking Mask	1		1C	dBHz	Not implemented
Navigation Mask	1		21	dBHz	Range 20 to 50

Payload Length: 3 bytes

2.1.14 Editing Residual – Message I.D. 141

This message is defined as Editing Residual but has not been implemented.

2.1.15 Steady State Detection - Message I.D. 142

This message is defined as Steady State Detection but has not been implemented.

2.1.16 Static Navigation – Message I.D. 143

This command allows the user to enable or disable static navigation to the Evaluation Receiver.

Example:

```
A0A20002 – Start Sequence and Payload Length
8F01 – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 51: Static Navigation

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		8F		ACSII 143
Static Navigation Flag	1		01		ASCII 1

Payload Length: 2 bytes

Table 52: Message ID 143 Description

Name	Description
Message ID	Message ID number.
Static Navigation Flag	Valid values: 1 enable static navigation 0 disable static navigation

2.1.17 Poll Clock Status – Message I.D. 144

Table 53 contains the input values for the following example:

```
Poll the clock status.
```

Example:

```
A0A20002 — Start Sequence and Payload Length
9000 — Payload
0090B0B3 — Message Checksum and End Sequence
```

Table 53: Clock Status

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		90		ACSII 144
Control	1		00		Not used

Payload Length: 2 bytes

Note: Returned message will be Message I.D. 7., see Chapter 2.2.7

2.1.18 Set DGPS Serial Port - Message I.D. 145

Table 54 contains the input values for the following example:

```
Set DGPS Serial port to 9600,n,8,1.
```

Example:

```
A0A20009 — Start Sequence and Payload Length
910000258008010000 — Payload
013FB0B3 — Message Checksum and End Sequence
```

Table 54: Set DGPS Serial Port

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		91		ASCII 145
Baud	4		00002580		38400,19200,9600,4800,2400,1200
Data Bits	1		08		8,7
Stop Bit	1		01		0,1
Parity	1		00		None = 0, Odd = 1, Even = 2
Pad	1		00		Reserved

Payload Length: 9 bytes

Note: Setting the DGPS serial port using MID 145 will effect Com B only regardless of the port being used to communicate with the Evaluation Receiver.

2.1.19 Poll Almanac - Message I.D. 146

Table 55 contains the input values for the following example:

```
Poll for the Almanac.
```

Example:

```
A0A20002 — Start Sequence and Payload Length
9200 — Payload
0092B0B3 — Message Checksum and End Sequence
```

Table 55: Almanac

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		92		ASCII 146
Control	1		00		Not used

Payload Length: 2 bytes

2.1.20 Poll Ephemeris - Message I.D. 147

Table 56 contains the input values for the following example:

```
Poll for Ephemeris Data for all satellites.
```

Example:

```
A0A20003 — Start Sequence and Payload Length
930000 — Payload
0092B0B3 — Message Checksum and End Sequence
```

Table 56: Ephemeris

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		93		ASCII 147
Sv I.D.[24]	1		00		Range 0 to 32
Control	1		00		Not used

Payload Length: 3 bytes

24 A value of 0 requests all available ephemeris records, otherwise the ephemeris of the Sv I.D. is requested.

2.1.21 Flash Update - Message I.D. 148

This command allows the user to command the Evaluation Receiver to go into internal boot mode without setting the boot switch. Internal boot mode allows the user to re-flash the embedded code in the receiver.

Note: It is highly recommended that all hardware designs should still provide access to the boot pin in the event of a failed flash upload.

Example:

```
A0A20001 – Start Sequence and Payload Length
94 – Payload
0094B0B3 – Message Checksum and End Sequence
```

Table 57: Flash Update

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		94		ASCII 148

Payload Length: 1 bytes

2.1.22 Set Ephemeris – Message I.D. 149

This command enables the user to upload an ephemeris file to the Evaluation Receiver.

Example:

```
A0A2005B – Start Sequence and Payload Length
95…………………. – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 58: Ephemeris

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		95		ASCII 149
Ephemeris Data	90		00		Reserved

Payload Length: 91 bytes

The ephemeris data for each satellite is stored as a two dimensional array of [3][15] UNIT16 elements. The figure 3 represents three separate sub-frames. The data is actually packed and the exact format of this representation and packing method can be extracted from the ICD-GPS-2000 document. The ICD-GPS-2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

2.1.23 Switch Operating Modes - Message I.D. 150

Table 59 contains the input values for the following example:

```
Sets the receiver to track a single satellite on all channels.
```

Example:

```
A0A20007 — Start Sequence and Payload Length
961E510006001E — Payload
0129B0B3 — Message Checksum and End Sequence
```

Table 59: Switch Operating Modes

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		96		ASCII 150
Mode	2		1E51		0 = normal 1E51 = Test Mode1, 1E52 = Test Mode2 1E53 = Test Mode3 1E54 = Test Mode4
SvID	2		0006		Satellite to Track
Period	2		001E	s	Duration of Track

Payload Length: 7 bytes

2.1.24 Set Trickle Power Parameters - Message I.D. 151

Table 60 contains the input values for the following example:

```
Sets the receiver into low power Modes.
```

Example: Set receiver into Trickle Power at 1 Hz update and 200 ms On Time.

```
A0A20009 — Start Sequence and Payload Length
97000000C8000000C8 — Payload
0227B0B3 — Message Checksum and End Sequence
```

Table 60: Set Trickle Power Parameters

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		97		ASCII 151
Push-To-Fix Mode	2		0000		ON = 1, OFF = 0
Duty Cycle	2	*10	00C8	%	% Time ON. A duty cycle of 1000 (100%) means continuous operation.
ms On Time	4		000000C8	ms	range 200 - 900 ms

Payload Length: 9 bytes

On-times of 700, 800, and 900 ms are invalid if an update rate of 1 second is selected.

Computation of Duty Cycle and On Time

The Duty Cycle is the desired time to be spent tracking. The On Time is the duration of each tracking period (range is 200 - 900 ms). To calculate the Trickle Power update rate as a function of Duty Cycle and On Time, use the following formula:

```
Off Time = On Time - (Duty Cycle * On Time)
                Duty Cycle

Update rate = Off Time + On Time
```

Note: It is not possible to enter an on-time > 900 ms

Following are some examples of selections:

Table 61: Example of Selections for Trickle Power Mode of Operation

Mode	On Time (ms)	Duty Cycle (%)	Update Rate(1/Hz)
Continuous	1000	100	1
Trickle Power	200	20	1
Trickle Power	200	10	2
Trickle Power	300	10	3
Trickle Power	500	5	10

Note: To confirm the receiver is performing at the specified duty cycle and ms On Time, see “The 12-Channel Signal Level View Screen” “Using the SiRFdemo Software”. The C/No data bins will be fully populated at 100% duty and only a single C/No data bin populated at 20% duty cycle. Your position should be updated at the computed update rate.

Table 62: Trickle Power Supported Modes

	Update Rates (seconds)									
On Time (ms)	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
200	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
300	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
400	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
500	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
600	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
700		✓	✓	✓	✓	✓	✓	✓	✓	✓
800		✓	✓	✓	✓	✓	✓	✓	✓	✓
900		✓	✓	✓	✓	✓	✓	✓	✓	✓

Push-to-Fix mode
In this mode the receiver will turn on every 30 minutes to perform a system update consisting of a RTC calibration and satellite ephemeris data collection if required (i.e., a new satellite has become visible) as well as all software tasks to support SnapStart in the event of an NMI. Ephemeris collection time in general takes 18 to 30 seconds. If ephemeris data is not required then the system will re-calibrate and shut down. In either case, the amount of time the receiver remains off will be in proportion to how long it stayed on:

```
Off period = On Period*(1-Duty Cycle)
             Duty Cycle
```

The off period has a possible range between 10 and 7200 seconds. The default is 1800 seconds.

2.1.25 Poll Navigation Parameters - Message I.D. 152

Table 63 contains the input values for the following example:

Example: Poll receiver for current navigation parameters.

```
A0A20002 — Start Sequence and Payload Length
9800 — Payload
0098B0B3 — Message Checksum and End Sequence
```

Table 63: Poll Receiver for Navigation Parameters

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		98		ASCII 152
Reserved	1		00		Reserved

Payload Length: 2 bytes

2.1.26 Set UART Configuration - Message I.D. 165

Table 64 contains the input values for the following example:

```
Example: Set port 0 to NMEA with 9600 baud, 8 data bits, 1 stop bit,
no parity. Set port 1 to SiRF binary with 57600 baud, 8 data bits, 1
stop bit, no parity. Do not configure ports 2 and 3.
```

Example:

```
A0A20031 — Start Sequence and Payload Length
A50001010000258008010000000100000000E1000801000000FF050500000000000
0000000FF0505000000000000000000 — Payload
0452B0B3 — Message Checksum and End Sequence
```

Table 64: Set UART Configuration

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		A5		Decimal 165
Port	1		00		For UART 0
In Protocol[25]	1		01		For UART 0
Out Protocol	1		01		For UART 0 (Set to IN-protocol)
Baud Rate[26]	4		00002580		For UART 0
Data Bits[27]	1		08		For UART 0
Stop Bits[28]	1		01		For UART 0
Parity[29]	1		00		For UART 0
Reserved	1		00		For UART 0
Reserved	1		00		For UART 0
Port	1		01		For UART 1
In Protocol	1		00		For UART 1
Out Protocol	1		00		For UART 1
Baud Rate	4		0000E100		For UART 1
Data Bits	1		08		For UART 1
Stop Bits	1		01		For UART 1
Parity	1		00		For UART 1
Reserved	1		00		For UART 1
Reserved	1		00		For UART 1
Port	1		FF		For UART 2
In Protocol	1		05		For UART 2
Out Protocol	1		05		For UART 2
Baud Rate	4		00000000		For UART 2
Data Bits	1		00		For UART 2
Stop Bits	1		00		For UART 2
Parity	1		00		For UART 2
Reserved	1		00		For UART 2
Reserved	1		00		For UART 2
Port	1		FF		For UART 3
In Protocol	1		05		For UART 3

25 0 = SiRF Binary, 1 = NMEA, 2 = ASCII, 3 = RTCM, 4 = User1, 5 = No Protocol.
26 Valid values are 1200, 2400, 4800, 9600, 19200, 38400, and 57600.
27 Valid values are 7 and 8.
28 Valid values are 1 and 2.
29 0 = None, 1 = Odd, 2 = Even.

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Out Protocol	1		05		For UART 3
Baud Rate	4		00000000		For UART 3
Data Bits	1		00		For UART 3
Stop Bits	1		00		For UART 3
Parity	1		00		For UART 3
Reserved	1		00		For UART 3
Reserved	1		00		For UART 3

Payload Length: 49 bytes

2.1.27 Set Message Rate - Message I.D. 166

Table 65 contains the input values for the following example:

```
Set message ID 2 to output every 5 seconds starting immediately.
```

Example:

```
A0A20008 — Start Sequence and Payload Length
A601020500000000 — Payload
00AEB0B3 — Message Checksum and End Sequence
```

Table 65: Set Message Rate

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		A6		decimal 166
Send Now[30]	1		01		Poll message
MID to be set	1		02		
Update Rate	1		05	s	Range = 1 - 30
Reserved	1		00		Not used
Reserved	1		00		No used
Reserved	1		00		Not used
Reserved	1		00		Not used

Payload Length: 8 bytes

30 0 = No, 1 = Yes, if no update rate the message will be polled.

2.1.28 Set Low Power Acquisition Parameters - Message I.D. 167

Table 66 contains the input values for the following example:
Set maximum off and search times for re-acquisition while receiver is in low power and using Adaptive TricklePower.

Example:

```
A0A2000F—Start Sequence and Payload Length
A7000075300001D4C00000003C0001—Payload
031EB0B3—Message Checksum and End Sequence
```

Table 66: Set Low Power Acquisition Parameters

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		A7		Decimal 167
Max Off Time	4		00007530	ms	Maximum time for sleep mode Default value: 30 seconds
Max Search Time	4		0001D4C0	ms	Max. satellite search time Default value: 120 seconds
Push-to-Fix Period	4		0000003C	s	Push-to-Fix cycle period
Adaptive TricklePower	2		0001		To enable Adaptive TricklePower 0 = off; 1 = on

Payload Length: 15 bytes

2.1.29 Poll Command Parameters – Message I.D. 168

Table 67 contains the input values for the following example:
Queries the receiver to send specific response messages for one of the following messages:
`0x80, 0x85, 0x88, 0x89, 0x8A, 0x8B, 0x8C, 0x8F, and 0x97.`

Example:

```
A0A20002 – Start Sequence and Payload Length
A897-Payload
013FB0B3-Message Checksum and End Sequence
```

Table 67: Poll Command Parameters

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		A8		Decimal 168
Poll Msg ID	1		97		Requesting Msg ID 0x97

Payload Length: 2 bytes

2.1.30 Set SBAS Parameters – Message I.D. 170

This command allows the user to set the SBAS parameters. Table 68 contains the input values for the following example:
Set automatic SBAS search and testing operating mode.

Example:

A0A20006—Start Sequence and Payload Length
AA0000010000—Payload
01B8B0B3—Message Checksum and End Sequence

Table 68: Poll SBAS Parameters

Name	Bytes	Binary (Hex)		Unit	Description
		Scale	Example		
Message ID	1		AA		Decimal 170
SBAS PRN	1		00		0 = Auto mode PRN 120-138 = exclusive
SBAS Mode	1		00		0 = Testing 1 = Integrity Integrity mode will not accept SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept and use SBAS corrections even if the SBAS satellite is transmitting in a test mode.
Flag Bit	1		01		Bit 0: Timeout; 0 = Default 1 = User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0 = Default 1 = User
Spare	2		0000		

2.1.31 Set UART Configuration - Message I.D. 182

This message is obsolete and is no longer used or supported.

2.2 Output Messages for SiRF Binary Protocol

Note: All output messages are received in BINARY format. SiRFdemo interprets the binary data and saves it to the log file in **ASCII format.**

Table 69 lists the message list for the SiRF output messages.

Table 69: SiRF Messages - Output Message List

Hex	ASCII	Name	Description
0 x 01	1	Reference Navigation Data	Not implemented
0 x 02	2	Measured Navigation Data	Position, velocity, and time
0 x 03	3	True Tracker Data	Not Implemented
0 x 04	4	Measured Tracking Data	Satellite and C/No information
0 x 05	5	Raw Track Data	Not supported by SiRFstarII
0 x 06	6	SW Version	Receiver software
0 x 07	7	Clock Status	Current clock status
0 x 08	8	50 BPS Subframe Data	Standard ICD format
0 x 09	9	Throughput	Navigation complete data
0 x 0A	10	Error ID	Error coding for message failure
0 x 0B	11	Command Acknowledgment	Successful request
0 x 0C	12	Command NAcknowledgment	Unsuccessful request
0 x 0D	13	Visible List	Auto Output
0 x 0E	14	Almanac Data	Response to Poll
0 x 0F	15	Ephemeris Data	Response to Poll
0 x 10	16	Test Mode 1	For use with SiRFtest (Test Mode 1)
0 x 11	17	Differential Corrections	Received from DGPS broadcast
0 x 12	18	OkToSend	CPU ON / OFF (Trickle Power)
0 x 13	19	Navigation Parameters	Response to Poll
0 x 14	20	Test mode 2/3/4	Test mode 2, 3, or 4 test data
0 x 1C	28	Nav. Lib. Measurement Data	Measurement Data
0 x 1D	29	Nav. Lib. DGPS Data	Differential GPS Data
0 x 1E	30	Nav. Lib. SV State Data	Satellite State Data
0 x 1F	31	Nav. Lib. Initialization Data	Initialization Data
0 x 29	41	Geodetic navigation data	Geodetic navigation information including error estimates
0 x 2E	46	Test mode 3	Additional test data (Test mode 3)
0 x 30	48	Test mode raw measurement data	Raw GPS measurement data

Hex	ASCII	Name	Description
0 x 31	49	Test mode raw tracking loop data	Raw tracking loop data
0 x 32	50	SBAS parameters	SBAS operating parameters
0 x 34	52	PPS time message	Time message for PPS
0 x 62		Extended Measured Navigation	Position output
0 x FF	255	Development data	Various status messages

2.2.1 Reference Navigation Data – Message I.D. 1

This message is defined as Reference Navigation data but has not been implemented.

2.2.2 Measure Navigation Data Out - Message I.D. 2

Output Rate: 1 Hz
Table 70 lists the binary and ASCII message data format for the measured navigation data.

Example:

```
A0A20029 — Start Sequence and Payload Length
02FFD6F78CFFBE536E003AC004000000003000104A00036B039780E3
0612190E160F04000000000000 — Payload
09BBB0B3 — Message Checksum and End Sequence
```

Table 70: Measured Navigation Data Out - Binary & ASCII Message Data Format

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		02			2
X-position	4		FFD6F78C	m		-2689140
Y-position	4		FFBE536E	m		-4304018
Z-position	4		003AC004	m		3850244
X-velocity	2	*8	0000	m/s	Vx÷8	0
Y-velocity	2	*8	0003	m/s	Vy÷8	0.375
Z-velocity	2	*8	0001	m/s	Vz÷8	0.125
Mode 1	1		04	Bitmap[31]		4
DOP[32]	1	*5	A		÷5	2.0
Mode 2	1		00	Bitmap[33]		0
GPS Week	2		036B			875
GPS TOW	4	*100	039780E3	s	÷100	602605.79
SVs in Fix	1		06			6
CH 1 PRN	1		12			18

31 For further information, go to table 61.
32 Dilution of precision (DOP) field contains the HDOP value only.
33 For further information, go to table 62.

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
CH 2 PRN	1		19			25
CH 3 PRN	1		0E			14
CH 4 PRN	1		16			22
CH 5 PRN	1		0F			15
CH 6 PRN	1		04			4
CH 7 PRN	1		00			0
CH 8 PRN	1		00			0
CH 9 PRN	1		00			0
CH 10 PRN	1		00			0
CH 11 PRN	1		00			0
CH 12 PRN	1		00			0

Payload Length: 41 bytes

Note: Binary units scaled to integer values need to be divided by the scale value to receive true decimal value (i.e., decimal X_{vel} = binary X_{vel} ÷ 8).

Note: The PRNs listed with the 12 channel fields will only contain PRNs of satellites actually used in the solution.

Table 71: Mode 1

Bit	7	6	5	4	3	2	1	0
Bit(s) Name	DGPS	DOP- Mask	ALTMODE		TPMODE	PMODE		

Bit(s) Name	Name	Value	Description
PMODE	Position mode	0	No navigation solution
		1	1 satellite solution
		2	2 satellite solution
		3	3 satellite solution
		4	>3 satellite solution
		5	2D point solution (Least square)
		6	3D point solution (Least square)
		7	Dead reckoning
TPMODE	Trickle Power mode	0	Full power position
		1	Trickle power position
ALTMODE	Altitude mode	0	No altitude hold
		1	Altitude used from filter
		2	Altitude used from user
		3	Forced altitude (from user)
DOPMASK	DOP mask status	0	DOP mask not exceeded
		1	DOP mask exceeded
DGPS	DGPS status	0	No DGPS position
		1	DGPS position

Table 72: Mode 2

Mode 2		Description
Hex	**ASCII**	
0 x 00	0	Solution not validated
0 x 01	1	DR Sensor Data (DR software versions only) 1 = DR Valid, 0 = Invalid, see bits 0x40 and 0x80
0 x 02	2	Validated (1)[34], Unvalidated (0)
0 x 04	4	If set, Dead Reckoning (Time Out)
0 x 08	8	If set, output edited by UI (i.e., DOP Mask exceeded)
0 x 10	16	Velocity is unvalidated
0 x 20	32	Altitude hold is disabled
0 x 40	64	Reason Sensor DR is invalid (bit 0x01 = 0) (DR software versions only) 00 = GPS navigation only, 01 = Calibrating DR sensors, 10 = DR Sensor error, 11 = DR Test mode
0 x 80	128	Reason Sensor DR is invalid (bit 0x01 = 0) (DR software versions only) 00 = GPS navigation only, 01 = Calibrating DR sensors, 10=DR Sensor error, 11=DR Test mode

(1) From an unvalidated state, a 5 SV position solution must be achieved to become a validated position. If the receiver continues to navigate in a degraded mode (3D, 2D, 1SV, or DR), then the validated status will remain. If navigation is lost completely, an unvalidated status will result.

34 For validated and unvalidated definitions, see "The 12-Channel Signal Level View Screen" on page .., table .., "Using the SiRFdemo Software".

2.2.3 True Tracker Data - Message I.D. 3

This message is defined as True Tracker data but has not been implemented.

2.2.4 Measured Tracker Data Out - Message I.D. 4

Output Rate: 1 Hz

Table 63 lists the binary and ASCII message data format for the measured tracker data.

Example:

```
A0A200BC — Start Sequence and Payload Length
04036C0000937F0C0EAB46003F1A1E1D1D191D1A1A1D1F1D59423F1A1A... —
Payload
....B0B3 — Message Checksum and End Sequence
```

Table 73: Measured Tracker Data Out

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		04	None		4
GPS Week	2		036C			876
GPS TOW	4	s*100	0000937F	s	S÷100	37759
Chans	1		0C			12
1st SVid	1		0E			14
Azimuth	1	Az*[2/3]	AB	deg	÷[2/3]	256.5
Elev	1	El*2	46	deg	÷2	35
State	2		003F	Bitmap[35]		0 x 3F
C/No 1	1		1A			26
C/No 2	1		1E			30
C/No 3	1		1D			29
C/No 4	1		1D			29
C/No 5	1		19			25
C/No 6	1		1D			29
C/No 7	1		1A			26
C/No 8	1		1A			26
C/No 9	1		1D			29
C/No 10	1		1F			31
2nd SVid	1		1D			29
Azimuth	1	Az*[2/3]	59	deg	÷[2/3]	89
Elev	1	El*2	42	deg	÷2	66
State	2		3F	Bitmap[36]		63
C/No 1	1		1A			26
C/No 2	1		1A			63
....						

Payload Length: 188 bytes

Note: Message length is fixed to 188 bytes with non-tracking channels reporting zero values.

35 For further information, see table 64 for TrktoNAVStruct.trk_status field definition.

36 For further information, see table 64 for TrktoNAVStruct.trk_status field definition.

Table 74: State Values for Each Channel

Bit	Description when bit is set to 1
0x0001	Acquisition and re-acquisition has been completed successfully
0x0002	The integrated carrier phase is valid
0x0004	Bit synchronization has been completed
0x0008	Subframe synchronization has been completed
0x0010	Carrier pulling has been completed
0x0020	Code has been locked
0x0040	Satellite acquisition has failed
0x0080	Ephemeris data is available

For complete information about possible tracking status messages, see "The 12-Channel Signal Level View Screen", "Using the SiRFdemo Software".

2.2.5 Raw Tracker Data Out - Message I.D. 5

This message is not supported by the SiRFstarII architecture.

2.2.6 Software Version String (Response to Poll) - Message I.D. 6

Output Rate: Response to polling message

Example:

```
A0A20015 — Start Sequence and Payload Length
0606312E322E30444B495431313920534D0000000000 — Payload
0382B0B3 — Message Checksum and End Sequence
```

Table 75: Software Version String

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		06			6
Character	20		[37]			[38]

Payload Length: 21 bytes

Note: Convert to symbol to assemble message (i.e., 0 x 4E is 'N'). These are low priority task and are not necessarily output at constant intervals.

37 06312E322E30444B495431313920534D0000000000

38 1.2.0DKit119 SM

2.2.7 Response: Clock Status Data - Message I.D. 7

Output Rate: 1 Hz or response to polling message

Example:

```
A0A20014 — Start Sequence and Payload Length
0703BD0215492408000122310004728 14D4DAEF — Payload
0598B0B3 — Message Checksum and End Sequence
```

Table 76: Clock Status Data Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		07			7
GPS Week	2		03BD			957
GPS TOW	4	*100	02154924	s	÷100	349494.12
Svs	1		08			8
Clock Drift	4		00012231	Hz		74289
Clock Bias	4		0004728	ns		128743715
Estimated GPS Time	4		14D4DAEF	ms		349493999

Payload Length: 20 bytes

2.2.8 50 BPS Data – Message I.D. 8

Output Rate: As available (12.5 minute download time)

Example:

```
A0A2002B — Start Sequence and Payload Length
08001900C0342A9B688AB0113FDE2D714FA0A7FFFACC5540157EFFEEDFFFA
80365A867FC67708BEB5860F4 — Payload
15AAB0B3 — Message Checksum and End Sequence
```

Table 77: 50 BPS Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		08			8
Channel	1		00			0
Sv I.D	1		19			25
Word[10]	40					

Payload Length: 43 bytes per subframe (5 subframes per page)

Note: Data is logged in ICD-GPS-200C format (available from www.navcen.uscg.mil). The 10 words together comprise a complete subframe of navigation message data. Within the word, the 30 bits of the navigation message word are justified, complete with 24 data bits and 6 parity bits. Any inversion of the data has been removed. The 2 MSBs of the word contain parity bits 29 and 30 in bits 31 and 30, respectively, from the previous navigation message word.

2.2.9 CPU Throughput – Message I.D. 9

Output Rate: 1 Hz

Example:

```
A0A20009 — Start Sequence and Payload Length
09003B0011001601E5 — Payload
0151B0B3 — Message Checksum and End Sequence
```

Table 78: CPU Throughput

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		09			9
SegStatMax	2	*186	003B	ms	÷186	.3172
SegStatLat	2	*186	0011	ms	÷186	.0914
AveTrkTime	2	*186	0016	ms	÷186	.1183
Last MS	2		01E5	ms		485

Payload Length: 9 bytes

2.2.10 Error ID Data – Message I.D. 10

Output Rate: Every measurement cycle (Full Power / Continuous: 1Hz)

Error ID: 2
Code Define Name: ErrId_CS_SVParity
Error ID Description: Satellite subframe # failed parity check.

Example:

```
A0A2000D – Start Sequence and Payload Length
0A0002000200000001000000002 – Payload
0011B0B3 – Message Checksum and End Sequence
```

Table 79: Error ID 2 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
	2		0002			2
	2		0002			2
	4		00000001			1
No	4		00000002			2

Payload Length: 13 bytes

Table 80: Error ID 2 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random Noise (PRN) number.
Subframe No	The associated subframe number that failed the parity check. Valid subframe number is 1 through 5.

Error ID: 9
Code Define Name: ErrId_RMC_GettingPosition
Error ID Description: Failed to obtain a position for acquired satellite ID.

Example:

```
A0A20009 – Start Sequence and Payload Length
0A0009000100000001 – Payload
0015B0B3 – Message Checksum and End Sequence
```

Table 81: Error ID 9 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		0009			9
Count	2		0002			2
Satellite ID	4		00000001			1

Payload Length: 9 bytes

Table 82: Error ID 9 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random Noise (PRN) number.

Error ID: 10
Code Define Name: ErrId_RXM_TimeExceeded
Error ID Description: Conversion of Nav Pseudo Range to Time of Week (TOW) for tracker exceeds limits: Nav Pseudo Range > 6.912e5 (1 week in seconds) || Nav Pseudo Range < -8.64e4.

Example:

```
A0A20009 – Start Sequence and Payload Length
0A000A000100001234 – Payload
005BB0B3 – Message Checksum and End Sequence
```

Table 83: Error ID 10 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000A			10
Count	2		0001			1
Pseudo Range	4		00001234			4660

Payload Length: 9 bytes

Table 84: Error ID 10 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Pseudo Range	Pseudo Range

Error ID: 11
Code Define Name: ErrId_RXM_TDOPOverflow
Error ID Description: Convert pseudo range rate to Doppler frequency exceeds limit.

Example:

```
A0A20009 – Start Sequence and Payload Length
0A000B0001xxxxxxxx – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 85: Error ID 11 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000B			11
Count	2		0001			1
Doppler Frequency	4		xxxxxxxx			xxxxxxxx

Payload Length: 9 bytes

Table 86: Error ID 11 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Doppler Frequency	Doppler Frequency

Error ID: 12
Code Define Name: ErrId_RXM_ValidDurationExceeded
Error ID Description: Satellite's ephemeris age has exceeded 2 hours (7200 s).

Example:
```
A0A2000D – Start Sequence and Payload Length
0A000C0002xxxxxxxxaaaaaaaa – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 87: Error ID 12 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000C			12
Count	2		0002			2
Satellite ID	4		xxxxxxxx			xxxxxxxx
Age Of Ephemeris	4		aaaaaaaa	s		aaaaaaaa

Payload Length: 13 bytes

Table 88: Error ID 12 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random Noise (PRN) number
Age Of Ephemeris	The Satellite's Ephemeris Age in seconds.

Error ID: 13
Code Define Name: ErrId_STRTP_BadPostion
Error ID Description: SRAM position is bad during a cold start.

Example:

```
A0A20011 – Start Sequence and Payload Length
0A000D0003xxxxxxxxaaaaaaaabbbbbbbb – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 89: Error ID 13 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		000D			13
Count	2		0003			3
X	4		xxxxxxxx			xxxxxxxx
Y	4		aaaaaaaa			aaaaaaaa
Z	4		bbbbbbbb			bbbbbbbb

Payload Length: 17 bytes

Table 90: Error ID 13 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
X	X position in ECEF.
Y	Y position in ECEF.
Z	Z position in ECEF.

Error ID: 4097 or 0x1001
Code Define Name: ErrId_MI_VCOClockLost
Error ID Description: VCO lost lock indicator.

Example:

```
A0A20009 – Start Sequence and Payload Length
0A1001000100000001 – Payload
001DB0B3 – Message Checksum and End Sequence
```

Table 91: Error ID 4097 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1001			4097
Count	2		0001			1
VCOLost	4		00000001			1

Payload Length: 9 bytes

Table 92: Error ID 4097 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
VCOLost	VCO lock lost indicator. If VCOLost ! = 0, then send failure message.

Error ID: 4099 or 0x1003
Code Define Name: ErrId_MI_FalseAcqReceiverReset
Error ID Description: Nav detect false acquisition, reset receiver by calling NavForceReset routine.

Example:

```
A0A20009 – Start Sequence and Payload Length
0A1003000100000001 – Payload
001FB0B3 – Message Checksum and End Sequence
```

Table 93: Error ID 4099 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1003			4099
Count	2		0001			1
InTrkCount	4		00000001			1

Payload Length: 9 bytes

Table 94: Error ID 4099 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
InTrkCount	False acquisition indicator. If InTrkCount </= 1, then send failure message and reset receiver.

Error ID: 4104 or 0x1008
Code Define Name: ErrId_STRTP_SRAMCksum
Error ID Description: Failed SRAM checksum during startup.

- Four field message indicates receiver control flags had checksum failures.
- Three field message indicates clock offset's checksum failure or clock offset value is out of range.
- Two field message indicates position and time checksum failure forces a cold start.

Example:

```
A0A2xxxx – Start Sequence and Payload Length
0A10080004xxxxxxxaaaaaaaa00000000cccccccc – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 95: Error ID 4104 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1008			4104
Count	2		0004 or 0003 or 0002			4 or 3 or 2
Computed Receiver Control Checksum	4		xxxxxxxx			xxxx
Battery backed Receiver Control Checksum	4		aaaaaaaa			aaaa
Battery backed Receiver Control OpMode	4		00000000			0
Battery backed Receiver Control Channel Count	4		cccccccc			cccc
Compute Clock Offset Checksum	4		xxxxxxxx			xxxx
Battery backed Clock Offset Checksum	4		aaaaaaaa			aaaa
Battery backed Clock	4		bbbbbbbb			bbbb

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Offset Computed Position Time Checksum	4		xxxxxxxx			xxxx
Battery backed Position Time Checksum	4		aaaaaaaa			aaaa

Payload Length: 21, 17, or 11 bytes

Table 96: Error ID 4104 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count Computed Receiver Control Checksum	Number of 32 bit data in message. Computed receiver control checksum of SRAM.Data.Control structure.
Battery backed Receiver Control Checksum	Battery backed receiver control checksum stored in SRAM.Data.DataBuffer. CntrlChkSum.
Battery backed Receiver Control OpMode	Battery backed receiver control checksum stored in SRAM.Data.Control.OpMode. Valid OpMode values are as follows: OP_MODE_NORMAL = 0, OP_MODE_TESTING = 0x1E51, OP_MODE_TESTING2 = 0x1E52, OP_MODE_TESTING3 = 0x1E53.
Battery backed Receiver Control Channel Count Compute Clock Offset Checksum	Battery backed receiver control channel count in SRAM.Data.Control.ChannelCnt. Valid channel count values are 0 - 12. Computed clock offset checksum of SRAM.Data.DataBuffer.clkOffset.
Battery backed Clock Offset Checksum	Battery backed clock offset checksum of RAM.Data.DataBuffer.clkChkSum.
Battery backed Clock Offset Computed Position Time Checksum	Battery backed clock offset value stored in RAM.Data.DataBuffer,clkOffset. Computed position time checksum of SRAM.Data.DataBuffer.postime[1]
Battery backed Position Time Checksum	Battery backed position time checksum of SRAM.Data.DataBuffer.postimeChkSum

Error ID: 4105 or 0x1009
Code Define Name: ErrId_STRTP_RTCTimeInvalid
Error ID Description: Failed RTC SRAM checksum during startup. If one of the double buffered SRAM.Data.LastRTC elements is valid and RTC days is not 255 days, then GPS time and week number computed from the RTC is valid. If not, this RTC time is invalid.

Example:
```
A0A2000D – Start Sequence and Payload Length
0A10090002xxxxxxxaaaaaaaa – Payload
xxxxB0B3 – Message Checksum and End Sequence
```

Table 97: Error ID 4105 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		1009			4105
Count TOW	2 4		0002 xxxxxxxx	 s		2 xxxx
Week Number	4		aaaaaaaa			aaaa

Payload Length: 13 bytes

Table 98: Error ID 4105 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count TOW	Number of 32 bit data in message. GPS time of week in seconds. Range 0 to 604800 seconds.
Week Number	GPS week number.

Error ID: 4106 or 0x100A
Code Define Name: ErrId_KFC_BackupFailed_Velocity
Error ID Description: Failed battery backing position because of ECEF velocity sum was greater than equal to 3600.

Example:
```
A0A20005 – Start Sequence and Payload Length
0A100A0000 – Payload
0024B0B3 – Message Checksum and End Sequence
```

Table 99: Error ID 4106 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100A			4106
Count	2		0000			0

Payload Length: 5 bytes

Table 100: Error ID 4106 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

Error ID: 4107 or 0x100B
Code Define Name: ErrId_KFC_BackupFailed_NumSV
Error ID Description: Failed battery backing position because current navigation mode is not KFNav and not LSQFix.

Example:

```
A0A20005 – Start Sequence and Payload Length
0A100B0000 – Payload
0025B0B3 – Message Checksum and End Sequence
```

Table 101: Error ID 4107 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		100B			4107
Count	2		0000			0

Payload Length: 5 bytes

Table 102: Error ID 4107 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

Error ID: 8193 or 0x2001
Code Define Name: ErrId_MI_BufferAllocFailure
Error ID Description: Buffer allocation error occurred. Does not appear to be active because uartAllocError variable never gets set to a non-zero value in the code.

Example:
```
A0A20009 – Start Sequence and Payload Length
0A2001000100000001 – Payload
002DB0B3 – Message Checksum and End Sequence
```

Table 103: Error ID 8193 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2001			8193
Count	2		0001			1
uartAllocError	4		00000001			1

Payload Length: 9 bytes

Table 104: Error ID 8193 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
uartAllocError	Contents of variable used to signal UART buffer allocation error.

Error ID: 8194 or 0x2002
Code Define Name: ErrId_MI_UpdateTimeFailure
Error ID Description: PROCESS_1SEC task was unable to complete upon entry. Overruns are occurring.

Example:
```
A0A2000D – Start Sequence and Payload Length
0A2002000200000001000000064 – Payload
0093B0B3 – Message Checksum and End Sequence
```

Table 105: Error ID 8194 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2002			8194
Count	2		0002			2
Number of in process errors.	4		00000001			1
Millisecond errors	4		00000064			100

Payload Length: 13 bytes

Table 106: Error ID 8194 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.
Number of in process errors	Number of one second updates not complete on entry.
Millisecond errors	Millisecond errors caused by overruns.

Error ID: 8195 or 0x2003
Code Define Name: ErrId_MI_MemoryTestFailed
Error ID Description: Failure of hardware memory test. Does not appear to be active because MemStatus variable never gets set to a non-zero value in the code.

Example:
```
A0A20005 – Start Sequence and Payload Length
0A20030000 – Payload
002DB0B3 – Message Checksum and End Sequence
```

Table 107: Error ID 8195 Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0A			10
Error ID	2		2003			8195
Count	2		0000			0

Payload Length: 5 bytes

Table 108: Error ID 8195 Message Description

Name	Description
Message ID	Message ID number.
Error ID	Error ID (see Error ID description above).
Count	Number of 32 bit data in message.

2.2.11 Command Acknowledgment – Message I.D. 11

Output Rate: Response to successful input message
This is successful almanac (message ID 0x92) request example:

```
A0A20002 — Start Sequence and Payload Length
0B92 — Payload
009DB0B3 — Message Checksum and End Sequence
```

Table 109: Command Acknowledgment

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0B			11
Ack. I.D.	1		92			146

Payload Length: 2 bytes

2.2.12 Command NAcknowledgment – Message I.D. 12

Output Rate: Response to rejected input message
This is an unsuccessful almanac (message ID 0x92) request example:

```
A0A20002 — Start Sequence and Payload Length
0C92 — Payload
009EB0B3 — Message Checksum and End Sequence
```

Table 110: Command NAcknowledgment

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0C			12
NAck. I.D.	1		92			146

Payload Length: 2 bytes

2.2.13 Visible List – Message I.D. 13

Output Rate: Updated approximately every 2 minutes

Note: This is a variable length message. Only the number of visible satellites are reported (as defined by Visible Svs in Table 111).

Example:

```
A0A2002A — Start Sequence and Payload Length
0D081D002A00320F009C0032.... — Payload
....B0B3 — Message Checksum and End Sequence
```

Table 111: Visible List

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		0D			13
Visible Svs	1		08			8
CH 1 - Sv I.D.	1		10			16
CH 1 - Sv Azimuth	2		002A	deg		42
CH 1 - Sv Elevation	2		0032	deg		50
CH 2 - Sv I.D.	1		0F			15
CH 2 - Sv Azimuth	2		009C	deg		156
CH 2 - Sv Elevation	2		0032	deg		50
.....						

Payload Length: Variable

2.2.14 Almanac Data - Message I.D. 14

Output Rate: Response to poll

Example:

```
A0A2001E — Start Sequence and Payload Length
0E0111014128FF630D51FD5900A10CC111B454B909098C6CE7
14............... — Payload
09E5B0B3 — Message Checksum and End Sequence
```

Table 112: Almanac Data

Name	Bytes	Binary (Hex)		Notes
		Scale	Example	
Message ID	1		0E	
SV ID	1		01	Satellite PRN Number[1]
Almanac week & status	2		1101	First 10 bits is the Almanac week. Next 5 bits have a zero value. Last bit is 1.
Almanac data	24		………	This information is taken from the 50BPS navigation message broadcast by the satellite. This information is the last 8 words in the 5th subframe but with the parity removed.[2]
Package Checksum	2		4CA1	This is the checksum of the preceding data in the payload. It is calculated by arranging the previous 26 bytes as 13 half-words and then summing them.[3]

Payload Length: 30 bytes

[1] Each satellite almanac entry is output in a single message.
[2] There are 25 possible pages in subframe 5. Pages 1 through 24 contain satellite specific almanac information which is output as part of the almanac data. Page 25 contains health status flags and the almanac week number.
[3] This checksum is not used for serial I/O data integrity. It is used internally for ensuring that almanac information is valid.

The data is actually packed and the exact format of this representation and packing method can be extracted from the ICD-GPS-2000 document. The ICD-GPS-2000 document describes the data format of each GPS navigation sub-frame and is available on the web at http://www.arinc.com/gps.

2.2.15 Ephemeris Data (Response to Poll) – Message I.D. 15

The ephemeris data that is polled from the receiver is in a special SiRF format based on the ICD- GPS -200 format for ephemeris data.

Output Rate: Response to poll
Example:

```
A0 A2 00 5C —Start Sequence and Payload Length
0F 1A 00 1A 00 8B D3 A5 3A 11 01 3B 15 B8 8A 99 FC 88 D4 40 31 3B F2
DD
69 78 00 FF 9E 38 F6 B6 00 1A 00 8B D4 29 DD FB 5C 31 0E F1 79 A6 4D
FC
1F 07 AB F1 29 00 F7 A1 0D 12 7F 69 78 7D 00 1A 00 8B D2 2E 00 37 CB
F8
C1 D1 00 7F 27 ED E1 D9 2F 2D 16 5A DB D8 FF A2 0C DD F6 F9 —Payload
2A 55 B0 B3—Message Checksum and End Sequence
```

Table 113: Ephemeris Data

Name	Bytes	Binary (Hex)		Notes
		Scale	Example	
Message ID	1		0F	Message I.D.
Satellite I.D.	1		1A	Satellite PRN Number [1]
Data	90		....	UINT16 [3] [15] array with subframes 1 to 3 data. See description below.

Payload Length: 92 bytes

[1] Each satellite almanac entry is output in a single message.

The data area consists of a 3x15 array of unsigned integers, 16 bits long. The first word of each row in the array ([0][0], [1][0] and [2][0]) will contain the satellite ID. The remaining words in the row will contain the data from the navigation message subframe, with row [0] containing subframe 1, row [1] containing subframe 2, and row [2] containing subframe 3. Data from the subframe is stored in a packed format, meaning that the 6 parity bits of each 30-bit navigation message word have been removed, and the remaining 3 bytes are stored in 1.5 16-bit words. Since the first word of the subframe, the TLM or telemetry word, does not contain any data needed by the receiver, it is not saved. Thus, there are 9 remaining words, with 3 bytes each, in each subframe. This total of 27 bytes is stored in 14 16-bit words. The second word of the subframe, the HOW or Handoff Word, has its most significant byte (MSB) stored as the least significant byte (LSB) of the first of the 16-bit words. Each following byte is stored in the next available byte of the array. Table 3-47 shows where each byte of the subframe is stored in the row of 16-bit words.

Table 114: Byte Positions between Navigation Message and Data Array

Navigation Message		Data Array	
Word	**Byte**	**Word**	**Byte**
2 (HOW)	MSB	[] [1]	LSB
2	Middle	[] [2]	MSB
2	LSB	[] [2]	LSB
3	MSB	[] [3]	MSB
3	Middle	[] [3]	LSB
3	LSB	[] [4]	MSB
4	MSB	[] [4]	LSB
4	Middle	[] [5]	MSB
4	LSB	[] [5]	LSB
5	MSB	[] [6]	MSB
5	Middle	[] [6]	LSB
5	LSB	[] [7]	MSB
6	MSB	[] [7]	LSB
6	Middle	[] [8]	MSB
6	LSB	[] [8]	LSB
7	MSB	[] [9]	MSB
7	Middle	[] [9]	LSB
7	LSB	[] [10]	MSB
8	MSB	[] [10]	LSB
8	Middle	[] [11]	MSB
8	LSB	[] [11]	LSB
9	MSB	[] [12]	MSB
9	Middle	[] [12]	LSB
9	LSB	[] [13]	MSB
10	MSB	[] [13]	LSB
10	Middle	[] [14]	MSB
10	LSB	[] [14]	LSB

Note: Message ID 149 uses the same format, except the Satellite ID (the second byte in Message ID 15) is omitted. Message ID 149 is thus a 91-byte message. The satellite ID is still embedded in elements [0][0], [1][0] and [2][0] of the data array.

2.2.16 Test Mode 1 - Message I.D. 16

Output Rate: Variable - set by the period as defined in message ID 150

Example:

```
A0A20011 — Start Sequence and Payload Length
100015001E000588B800C81B5800040001 — Payload
02D8B0B3 — Message Checksum and End Sequence
```

Table 115: Test Mode 1 Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		10			16
SV ID	2		0015			21
Period	2		001E	s		30
Bit Sync Time	2		0005	s		5
Bit Count	2		88B8			35000
Poor Status	2		00C8			200
Good Status	2		1B58			7000
Parity Error Count	2		0004			4
Lost VCO Count	2		0001			1

Payload Length: 17 bytes

Table 116: Detailed Description of Test Mode 1 Data

Name	Description
Message I.D.	Message I.D. number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20 s x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100ms of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 s x 10 s).
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 ms of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receiver's parity check.
Lost VCO Count	The number of 1 ms VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase causes a VCO lost lock.

2.2.17 Differential Corrections - Message I.D. 17

Message I.D. 17 provides the RTCM data received from a DGPS source. The data is sent as a SiRF Binary message and is based on the RTCM SC-104 format. For more information see *RTCM Recommended Standards for Differential GNSS* by the Radio *Technical Commission for Maritime Services*.

2.2.18 OkToSend - Message I.D. 18

Output Rate: Trickle Power CPU on/off indicator

Example:

```
A0A20002 — Start Sequence and Payload Length
1200 — Payload
0012B0B3 — Message Checksum and End Sequence
```

Table 117: Almanac Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		12			12
Send Indicator[39]	1		00			00

Payload Length: 2 bytes

2.2.19 Navigation Parameters (Response to Poll) – Message I.D. 19

Output Rate: 1 Response to Poll

Example:

```
A0 A2 00 41 —Start Sequence and Payload Length
13 00 00 00 00 00 00 00 01 1E 0F 01 00 01 00 00 00 00 04 00 4B 1C
00 00 00
00 02 00 1E 00 00 00 00 00 00 00 03 E8 00 00 03 E8 00 00 00 00 00 00
00 00 00
00 00 00 00 00 00 00 00 00 00 00 00 00—Payload

02 A4 B0 B3—Message Checksum and End Sequence
```

39 0 implies that CPU is about to go OFF, OkToSend==NO, 1 implies CPU has just come ON, OkToSend==YES

Table 118: Navigation Parameters

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		13			19
Sub ID[1]	1		00			
Reserved	3		00			
Altitude Hold Mode	1		00			
Altitude Hold Source	1		00			
Altitude Source Input	2		0000	m		
Degraded Mode[40]	1		00			
Degraded Timeout	1		00	s		
DR Timeout	1		01	s		
Track Smooth Mode	1		1E			
Static Navigation	1		0F			
3SV Least Squares	1		01			
Reserved	4		00000000			
DOP Mask Mode[41]	1		04			
Navigation Elevation Mask	2		004B			
Navigation Power Mask	1		1C			
Reserved	4		00000000			
DGPS Source	1		02			
DGPS Mode[42]	1		00			0
DGPS Timeout	1		1E	s		30
Reserved	4		00000000			
LP Push-to-Fix	1		00			
LP On-time	4		00003E8			
LP Interval	4		00003E8			
User Tasks Enabled[43]	1		00			
User Task Interval	4		00000000			
LP Power Cycling Enabled	1		00			
LP Max. Acq. Search Time	4		00000000	s		

40 See table 34.
41 See table 36.
42 See table 38.
43 User task enabled – scheduled from 100ms interrupt and the idle loop

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
LP Max. Off Time	4		00000000	s		
APM Enabled /Power Duty Cycle[44]	4		00			
Number of Fixes	4		0000			
Time between Fixes			0000	s		
Horizontal/vertical error Max[45]			00	m		
Response Time Max			00	s		
Time/Accuracy & Time/Duty Cycle Priority[46]			00			

Payload Length: 65 bytes

Table 119: Horizontal / vertical error

Value	Position error (in m)
0x00	< 1m
0x01	< 5m
0x02	< 10m
0x03	< 20m
0x04	< 40m
0x05	< 80m
0x06	< 160m
0x07	No maximum
0x08 – 0x0FF	Reserved

44Bit 7: APM enabled, 1: enabled, 0: disabled, Bit 4-0: power duty cycle, Range: 1-20 scaled to 5%, 1: 5%, 2: 10%… 20: 100%

45See Table 119

46Bit 3-2: Time accuracy, 0x00 = No priority imposed, 0x01 = RESP_TIME_MAX has higher priority, 0x02 = HORI_ERR_MAX has higher priority, Bit1-0: time duty cycle, 0x01 = Time between two consecutive fixes has priority, 0x02 = Power duty cycle has higher priority

2.2.20 Test Mode 2, 3, 4 - Message I.D. 20

The definition of MID 20 is different depending on the version and type of software being used. For GSW2, MID 20 is defined as Test Mode 2 only. For SiRFLoc or SiRFXTrac, MID can be either Test Mode 2, Test Mode 3, or Test Mode 4. For GSW2 software, refer to MID 46 for test mode 3 and test mode 4 results.

Output Rate: Variable - set by the period as defined in message ID 150

Test mode 2:

This is supported by either GSW2, SiRFLoc, or SiRFXTrac. Test Mode 2 requires approx. 1.5 minutes of data collection before sufficient data is available.

Example:

```
A0A20033—Start Sequence and Payload Length
140001001E00023F70001F0D290000000000000601C600051B0E000EB41A000000000000
0
00000000000000000000000000000000—Payload
0316B0B3—Message Checksum and End Sequence
```

Table 120: Test Mode 2 Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		14			20
SV ID	2		0001			1
Period	2		001E	s		30
Bit Sync Time	2		0002	s		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	s		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift	2	*10	1B0E	Hz	÷10	692.6
Clock Offset	4	*10	000EB41A	Hz	÷10	96361.0
Reserved	2		0000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			

Payload Length: 51 bytes

Table 121: Detailed Description of Test Mode 2 Data

Name	Description
Message I.D.	Message I.D. number.
SV ID	The number of the satellite being tracked.
Period	The total duration of time (in seconds) that the satellite is tracked.
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37.
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50bps x 20 s x 12 channels).
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100ms of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 s x 10 s)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100 ms of phase lock equates to 1 good status count.
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receiver's parity check.
Lost VCO Count	The number of 1 ms VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock.
Frame Sync	The time it takes for channel 0 to reach a 3F status.
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period.
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period.
Clock Drift	Difference in clock frequency from start and end of the test period.
Clock Offset	The internal clock offset.

Test mode 3:

This is supported by SiRFLoc and SiRFXTrac only as MID 20. Test mode 3 requires approx. 10s of data collection before sufficient data is available.

Example:

```
A0A20033—Start Sequence and Payload Length
140001001E00023F70001F0D290000000000000601C600051B0E000EB41A0000000000000
0000000000000000000000000000000—Payload
0316B0B3—Message Checksum and End Sequence
```

Table 122: Test Mode 3 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		14			20
SV I:D.	2		001			1
Period	2		001E	s		30
Bit Sync Time	2		0002	s		2
Bit Count	2		3F70			13680
Poor Status	2		001F			31
Good Status	2		0D29			3369
Parity Error Count	2		0000			0
Lost VCO Count	2		0000			0
Frame Sync Time	2		0006	s		6
C/No Mean	2	*10	01C6		÷10	45.4
C/No Sigma	2	*10	0005		÷10	0.5
Clock Drift	4	*10	1B0E	Hz	÷10	692.6
Clock Offset	2	*10	000EB41A	Hz	÷10	96361.0
Bad 1KHz Bit Count	4		0000			
Abs I20ms	4		00000000			
Abs Q1ms	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			

Payload Length: 51 bytes

Table 123: Detailed Description of Test Mode 3 Message

Name	Description
Message I.D.	Message I.D. number
SV I.D.	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20 second test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20sec x 12 channels)
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60 second period is 7200 (12 channels x 60 sec x 10 sec)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100msec of phase lock equates to 1 good status count
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check
Lost VCO Count	The number of 1 ms VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock
Frame Sync	The time it takes for channel 0 to reach a 3F status
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period
Clock Drift	Difference in clock frequency from start and end of the test period
Clock Offset	The internal clock offset
Bad 1KHz Bit Count	Errors in 1ms post correlation I count values
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period.

Test Mode 4:

This is supported by SiRFLoc and SiRFXTrac only.

Table 124: Test Mode 4 Message

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		14			20
Test Mode	1		04			4
Test Variant	1		01	s		1
SV ID	2		0001	s		1
Period	2		001E			30
Bit Sync Time	2		0002			2
C/No Mean	2	*10	01C6		÷10	45:4
C/No Sigma	2	*10	0005		÷10	0:5
Clock Drift	2	*10	1B0E	Hz	÷10	692:6
Clock Offset	4	*10	000EB41A	Hz	÷10	96361:0
I Count Errors	2		0003			3
Abs I20ms	4		0003AB88			240520
Abs Q1ms	4		0000AFF0			45040

Payload Length: 29 bytes

Table 125: Detailed Description of Test Mode 4 Message

Name	Description
Message I.D.	Message I.D. number
Test Mode	3= Testmode 3, 4=Testmode 4
Test Variant	The variant # of the message (variant change indicates possible change in number of fields or field description)
SV ID	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period
Clock Drift	Difference in clock frequency from start and end of the test period
Clock Offset	The internal clock offset
I Count Errors	Errors in 1ms post correlation I count values
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period

2.2.21 Navigation Library Measurement Data - Message I.D. 28

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
A0A20038 — Start Sequence and Payload Length
1C00000660D015F143F62C4113F42F417B235CF3FBE95E468C6964B8FBC582415
CF1C375301734.....03E801F400000000 — Payload
1533B0B3 — Message Checksum and End Sequence
```

Table 126: Measurement Data

Name	Bytes	Binary (Hex)		Units	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1C			28
Channel	1		00			0
Time Tag	4		000660D0	ms		135000
Satellite ID	1		15			20
GPS Software Time	8		F143F62C 4113F42F	ms		2.4921113 696e+005
Pseudo-range	8		417B235C F3FBE95E	m		2.1016756 638e+007
Carrier Frequency	4		468C6964	m/s		1.6756767 578e+004
Carrier Phase	8		B8FBC582 415CF1C3	m		4.4345542 262e+004
Time in Track	2		7530	ms		10600
Sync Flags	1		17			23
C/No 1	1		34	dBHz		43
C/No 2	1			dBHz		43
C/No 3	1			dBHz		43
C/No 4	1			dBHz		43
C/No 5	1			dBHz		43
C/No 6	1			dBHz		43
C/No 7	1			dBHz		43
C/No 8	1			dBHz		43
C/No 9	1			dBHz		43
C/No 10	1			dBHz		43
Delta Range Interval	2		03E801F4	m		1000
Mean Delta Range Time	2		01F4	ms		500
Extrapolation Time	2		0000	ms		
Phase Error Count	1		00			0
Low Power Count	1		00			0

Payload Length: 56 bytes

For GPS Software Time, Psuedorange, Carrier Frequency, and Carrier Phase, the fields are either floating point (4-byte fields) or double-precision floating point (8-byte fields), per IEEE-754 format. The byte order may have to be changed to be interpreted properly on some computers. Also, the byte order differs between GPS software versions 2.2.0 and earlier, and versions 2.3.0 and later.

To convert the data to be properly interpreted on a PC-compatible computer, do the following:
For double-precision (8-byte) values: Assume the bytes are transmitted in the order of B0, B1, ... , B7. For version 2.2.0 and earlier software, rearrange them to B3, B2, B1, B0, B7, B6, B5. B4 For version 2.3.0 and later software, rearrange them to B7, B6, B5, ... , B0.
For single-precision (4-byte) values: Assume bytes are transmitted in the order of B0, B1, B2 , B3 Rearrange them to B3, B2, B1, B0 (that is, byte B3 goes into the lowest memory address, B0 into the highest). With these re-mappings, the values should be correct. To verify, compare the same field from several satellites tracked at the same time. The reported exponent should be similar (within 1 power of 10) among all satellites. The reported Carrier Frequency contains a bias of the clock drift reported in MID 7. To adjust the reported carrier frequency do the following:
Corrected Carrier Frequency (m/s) = Reported Carrier Frequency (m/s) - Clock Drift (Hz) / 1575420000 Hz For a nominal clock drift value of 96.25 kHz (equal to a GPS Clock frequency of 24.5535 MHz), the correction value is 18315.766 m/s.

Table 127: Sync Flag Fields

Bit Fields	Description
[0]	**Coherent Integration Time** 0 = 2ms 1 = 10ms
[2:1]	**Synch State** 00 = Not aligned 01 = Consistent code epoch alignment 10 = Consistent data bit alignment 11 = No millisecond errors
[4:3]	**Autocorrelation Detection State** 00 = Verified not an autocorrelation 01 = Testing in progress 10 = Strong signal, autocorrelation detection not run 11 = Not used

Table 128: Detailed Description of the Measurement Data

Name	Description
Message I.D.	Message I.D. number.
Channel	Receiver channel number for a given satellite being searched or tracked.
Time Tag	This is the Time Tag in milliseconds of the measurement block in the receiver software time.
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random noise (PRN) number.
GPS Software Time	This is GPS Time or Time of Week (TOW) estimated by the software in milliseconds.
Pseudo-range	This is the generated pseudo range measurement for a particular SV.
Carrier Frequency	This is can be interpreted in two ways: 1) The delta-pseudo range normalized by the reciprocal of the delta pseudo range measurement interval. 2) The frequency from the AFC loop. If, for example, the delta pseudo range interval computation for a particular channel is zero, then it can be the AFC measurement, otherwise it is a delta-pseudo range computation.
Carrier Phase	This is the integrated carrier phase given in meters.
Time in Track	The Time in Track counts how long a particular SV has been in track. For any count greater than zero (0), a generated pseudo range is present for a particular channel. The length of time in track is a measure of how large the pull-in error may be.
Sync Flags	This byte contains two a two bit fields that report the integration interval and sync value achieved for a particular channel. 1. **Bit 0:** Coherent Integration Interval (0 = 2 ms, 1 = 10 ms) 2. **Bits:** (1 2) = Synchronization 3. **Bit:** (2 1) Value: {0 0} Not Aligned Value: {0 1} Consistent Code Epoch Alignment Value: {1 0} Consistent Data Bit Alignment Value: {1 1} No ms Errors
C/No 1	This array of Carrier To Noise Ratios is the average signal power in dBHz for each of the 100 ms intervals in the previous second or last epoch for each particular SV being track in a channel. First 100 ms measurement
C/No 2	Second 100 ms measurement
C/No 3	Third 100 ms measurement
C/No 4	Fourth 100 ms measurement
C/No 5	Fifth 100 ms measurement
C/No 6	Sixth 100 ms measurement
C/No 7	Seventh 100 ms measurement
C/No 8	Eighth 100 ms measurement
C/No 9	Ninth 100 ms measurement
C/No 10	Tenth 100 ms measurement

Name	Description
Delta Range Interval	This is the delta-pseudo range measurement interval for the preceding second. A value of zero indicated that the receiver has an AFC measurement or no measurement in the Carrier Frequency field for a particular channel.
Mean Delta Range Time	This is the mean calculated time of the delta-pseudo range interval in milliseconds measured from the end of the interval backwards
Extrapolation Time	This is the pseudo range extrapolation time in ms, to reach the common Time tag value.
Phase Error Count	This is the count of the phase errors greater than 60 Degrees measured in the preceding second as defined for a particular channel.
Low Power Count	This is the low power measurements for signals less than 28 dB-Hz in the preceding second as defined for a particular channel

2.2.22 Navigation Library DGPS Data - Message I.D. 29

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
A0A2001A — Start Sequence and Payload Length
1D000F00B501BFC97C673CAAAAAB3FBFFE1240A0000040A00000 — Payload
0956B0B3 — Message Checksum and End Sequence
```

Table 129: Measurement Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1D			29
Satellite ID	2		000F			15
IOD	2		00B5			181
Source[47]	1		01			1
Pseudo-range Correction	4		BFC97C67	m		-1.574109
Pseudo-range rate Correction	4		3CAAAA AB	m/s		0.020833
Correction Age	4		3FBFFE12	s		1.499941
Reserved	4					
Reserved	4					

Payload Length: 26 bytes

Note: The fields Pseudorange Correction, Pseudorange Rate Correction and Correction Age, are floating point values per IEEE-754. To properly interpret these in a PC, the bytes need to be rearranged into reverse order

47 0 = Use no corrections, 1 = Use WAAS channel, 2 = Use external source, 3 = Use Internal Beacon, 4 = Set DGPS Corrections

2.2.23 Navigation Library SV State Data - Message I.D. 30

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
A0A20053 — Start Sequence and Payload Length
1E15....2C64E99D01....408906C8 — Payload
2360B0B3 — Message Checksum and End Sequence
```

Table 130: SV State Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1E			30
Satellite ID	1		15			21
GPS Time	8			s		
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Velocity X	8			m/s		
Velocity Y	8			m/s		
Velocity Z	8			m/s		
Clock Bias	8			s		
Clock Drift	4		2C64E99D	1/s		744810909
Ephemeris Flag[48]	1		01			1
Reserved	4					
Reserved	4					
Ionospheric Delay	4		408906C8	m		1082721992

Payload Length: 83 bytes

48 0 = no valid SV state, 1 = SV state calculated from ephemeris, 2 = Satellite state calculated from almanac

2.2.24 Navigation Library Initialization Data - Message I.D. 31

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
A0A20054 — Start Sequence and Payload Length
1F....00000000000001001E000F....00....000000000F....00....02....043402
....
....02 — Payload
0E27B0B3 — Message Checksum and End Sequence
```

Table 131: Measurement Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1F			31
Reserved	1					
Altitude Mode[49]	1		00			0
Altitude Source	1		00			0
Altitude	4		00000000	m		0
Degraded Mode[50]	1		01			1
Degraded Timeout	2		001E	s		30
Dead-reckoning Timeout	2		000F	s		15
Reserved	2					
Track Smoothing Mode[51]	1		00			0
Reserved	1					
Reserved	2					
Reserved	2					
Reserved	2					
DGPS Selection[52]	1		00			0
DGPS Timeout	2		0000	s		0
Elevation Nav. Mask	2		000F			15
Reserved	2					
Reserved	1					
Reserved	2					
Reserved	1					

49 0 = Use last know altitude 1 = Use user input altitude 2 = Use dynamic input from external source

50 0 = Use direction hold and then time hold 1 = Use time hold and then direction hold 2 = Only use direction hold 3 = Only use time hold 4 = Degraded mode is disabled

51 0 = True 1 = False

52 0 = Use DGPS if available 1 = Only navigate if DGPS corrections are available 2 = Never use DGPS corrections

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Reserved	2					
Static Nav. Mode[53]	1		00			0
Reserved	2					
Position X	8			m		
Position Y	8			m		
Position Z	8			m		
Position Init. Source[54]	1		02			2
GPS Time	8					
GPS Week	2		0434			1076
Time Init. Source[55]	1		02			2
Drift	8					
Drift Init. Source[56]	1		02			2

Payload Length: 84 bytes

53 0 = True 1 = False

54 0 = ROM position 1 = User position 2 = SRAM position 3 = Network assisted position

55 0 = ROM time 1 = User time 2 = SRAM time 3 = RTC time 4 = Network assisted time

56 0 = ROM clock 1 = User clock 2 = SRAM clock 3 = Calibration clock 4 = Network assisted clock

2.2.25 Geodetic Navigation Data – Message I.D. 41

Output Rate:Every measurement cycle (full power / continuous : 1Hz)

Example:

```
A0 A2 00 5B—Start Sequence and Payload Length
29 00 00 02 04 04 E8 1D 97 A7 62 07 D4 02 06 11 36 61 DA 1A 80 01 58
16 47 03
DF B7 55 48 8F FF FF FA C8 00 00 04 C6 15 00 00 00 00 00 00 00 00 00
00 00 00
00 BB 00 00 01 38 00 00 00 00 00 00 6B 0A F8 61 00 00 00 00 00 1C 13
14 00 00
00 00 00 00 00 00 00 00 00 00 08 05 00—Payload
11 03 B0 B3—Message Checksum and End Sequence
```

Table 132: Measurement Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message I.D.	1		1F			41
NAV Valid	2					
NAV Type	2					
Extended Week Number	2			Week		
TOW	4			s		
UTC Year	2			Year		
UTC Month	1			Month		
UTC Day	2			d		
UTC Hour	2			h		
UTC Minute	2			Min		
UTC Second	2			s		
Satellite ID List	4					
Latitude	4			deg		
Longitude	4			deg		
Altitude from Ellipsoid	4			m		
Altitude from MSL	4			m		
Map Datum[57]	1					
Speed over Ground (SOG)	2			m/s		
Course over Ground (COG, True)	2			deg		
Magnetic Variation	2			deg		

57 Map datum indicates the datum to which latitude, longitude and altitude relate. 0 = WGS-84, by default. Other values will be defined as other datums are implemented.

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Climb Rate	2			m/s		
Heading Rate	2			deg/s		
Estimated Horizontal Position Error (EHPE)	4			m		
Estimated Vertical Position Error (EVPE)	4			m		
Estimated Time Error (ETE)	4			m		
Estimated Horizontal Velocity Error (EHVE)	2			m/s		
Clock Bias	4			m		
Clock Bias Error	4			m		
Clock Drift	4			m/s		
Clock Drift Error	4			m		
Distance traveled since RESET	4			m		
Distance Travel Error	2			m		
Heading Error	2			deg		
Number of SVs in Fix	1					
HDOP	1					
Reserved	1					

Payload Length: 91 bytes

Note – Values are transmitted as integer values. When scaling is indicated in the description, the decimal value has been multiplied by the indicated amount and then converted to an integer. Example: Value transmitted: 2345; indicated scaling: 102; actual value: 23.45.

Table 133: Detailed Description of Geodetic Navigation Data Message

Name	Description
Message I.D.	Message I.D. number
NAV Valid	Any bits not 0: Nav is invalid Bit 0 = 1: Position fix not validated Bit 1 = 1: Reserved (EHPE limits exceeded) Bit 2 = 1: Reserved (EVPE limits exceeded) Bit 3 = 1: DR data invalid Bit 4 = 1: DR Cal invalid Bit 5 = 1: GPS-based Cal not available Bit 6 = 1: DR Pos invalid Bit 7 = 1: DR Heading invalid Bit 8 - 15 = 1: Not defined
NAV Type	NAV Mode Bits definition: GPS Fix Type: bits 2 - 0: SVs used 000 No Nav 001 1 SV solution 010 2 SV solution 011 3 SV solution (2D) 100 4 or more SV (3D) 101 Least Sq 2D fix 110 Least Sq 3D fix 111 DR solution (0 SV) bit 3 = 1: Trickle Power On bits 5 - 4 Altitude hold 00 No Altitude hold 01 Filter Altitude used 10 Use Altitude used 11 User Forced Altitude bit 6 = 1: SIRFDRIVE On bit 7 = 1: DGPS corrections bit 8 = 1: Sensor Based DR bit 9 = 1: Sol Validated bit 10 = 1: VEL DR Timeout bit 11 = 1: Edited by UI bit 12 = 1: Velocity Valid bit 13 = 1: Altitude hold is disabled bit 14 - 15 = 1: Sensor DR status, 00 = GPS only

	solution, 01 = DR Calibration from GPS, 10 = DR Sensor Error, 11 = DR is in test
Extended Week Number	Range: 800 to 500
TOW	Range: 0 to 604800.00
UTC Year	Range: 1980 to 3000
UTC Month	Range: 1 to 12
UTC Day	Range: 1 to 31
UTC Hour	Range: 0 to 23
UTC Minute	Range: 0 to 60
UTC Second	Range: 0 to 60
Number of Satellites in Solution	Range: 0 to 12
Latitude	Range: -90 to 90
Longitude	Range: -180 to 180
Altitude from Ellipsoid	Range: -2000 to 1000000.0
Altitude from MSL	Range: -2000 to 1000000.0
Map Datum	Range: 0 to 255
Speed over Ground (SOG)	Range: 0 to 655
Course over Ground (COG, True)	Range: 0 to 360
Magnetic Variation	Range: -90 to 90
Climb Rate	Range: -300 to 300
Heading Rate	Range: -300 to 300
Estimated Horizontal Position Error (EHPE)	Range: 0 to 6000000
Estimated Vertical Position Error (EVPE)	Range: 0 to 24000
Estimated Time Error (ETE)	Range: 0 to 6000000
Estimated Horizontal Velocity Error (EHVE)	Range: 0 to 655
Clock Bias	Range: -90000 to 90000
Clock Bias Error	Range: 0 to 6000000
Clock Drift	Range: -1000 to 1000
Clock Drift Error	Range: 0 to 1000
Distance traveled since RESET	Range: 0 to 4294967295
Distance Travel Error	Range: 65535
Heading Error	Range: 0 to 180
Number of SVs in Fix	Count of satellites indicated by SVID list
HDOP	Horizontal Dilution of Precision
Reserved	Reserved

2.2.26 Test Mode 3, 4 - Message I.D. 46

Note: This message is used in GSW2 software only. For SiRFLoc and SiRFXTrac software, refer to MID 20.

Output Rate: Variable - set by the period as defined in message ID 150

Example:

```
A0A20033—Start Sequence and Payload Length
2E0001001E00023F70001F0D290000000000601C600051B0E000EB41A0000000000000
00000000000000000000000000000000—Payload
0316B0B3—Message Checksum and End Sequence
```

Table 134: Test Mode 3 Messsage

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		2E			30
SV ID	2		0001			2
Period	2		001E	s		13680
Bit Sync Time	2		0002	s		31
Bit Count	2		3F70			3369
Poor Status	2		001F			0
Good Status	2		0D29			0
Parity Error Count	2		0000			6
Lost VCO Count	2		0000			45.4
Frame Sync Time	2		0006	s		0.5
C/No Mean	2	*10	01C6		÷10	692.6
C/No Sigma	2	*10	0005		÷10	96361.0
Clock Drift	2	*10	1B0E	Hz	÷10	
Clock Offset	4	*10	000EB41A	Hz	÷10	
Bad 1KHz bit Count	2		0000			
Abs I20ms	4		00000000			
Abs Q1ms	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			
Reserved	4		00000000			

Payload Length: 51 bytes

Table 135: Detailed Description of Test Mode 3 Message

Name	Description
Message I.D.	Message I.D. number
SV I.D.	The number of the satellite being tracked
Period	The total duration of time (in seconds) that the satellite is tracked
Bit Sync Time	The time it takes for channel 0 to achieve the status of 37
Bit Count	The total number of data bits that the receiver is able to demodulate during the test period. As an example, for a 20s test period, the total number of bits that can be demodulated by the receiver is 12000 (50BPS x 20s x 12 channels)
Poor Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100msec of loss of phase lock equates to 1 poor status count. As an example, the total number of status counts for a 60s period is 7200 (12 channels x 60s x 10s)
Good Status	This value is derived from phase accumulation time. Phase accumulation is the amount of time a receiver maintains phase lock. Every 100ms of phase lock equates to 1 good status count
Parity Error Count	The number of word parity errors. This occurs when the transmitted parity word does not match the receivers parity check
Lost VCO Count	The number of 1 ms VCO lost lock was detected. This occurs when the PLL in the RFIC loses lock. A significant jump in crystal frequency and / or phase will cause a VCO lost lock
Frame Sync Time	The time it takes for channel 0 to reach a 3F status
C/No Mean	Calculated average of reported C/No by all 12 channels during the test period
C/No Sigma	Calculated sigma of reported C/No by all 12 channels during the test period
Clock Drift	Difference in clock frequency from start and end of the test period
Clock Offset	The internal clock offset
Bad 1KHz bit Count	Errors in 1ms post correlation I count values
Abs I20ms	Absolute value of the 20ms coherent sums of the I count over the duration of the test period
Abs Q1ms	Absolute value of the 1ms Q count over the duration of the test period

2.2.27 Test Mode Raw Measurement Data – Message I.D. 48

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
?—Start Sequence and Payload Length
300100000000000015000660D0F3FBE95E417B235C468C6964—Payload
?—Message Checksum and End Sequence
```

Table 136: Test Mode Raw Measurement Data Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		30			48
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		15			20
Receiver Time Tag	4		000660D0	ms		135000
Pseudo-range	4	*10	F3FBE95E 417B235C	m		2.1016756638e+007
Carrier Frequency	4	*10	468C6964	m/s		1.6756767578e+004

Payload Length: variable

Table 137: Detailed Description of Test Mode Raw Measurement Data Message

Name	Description
Message ID	Message I.D. number
nChannel	Number of channels reported
Reserved	Reserved
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random noise (PRN) number
Receiver Time Tag	This is the count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock
Pseudo-range	This is the generated pseudo range measurement for a particular SV
Carrier Frequency	This can be interpreted in two ways: 1. The delta-pseudo range normalized by the reciprocal of the delta pseudo range measurement interval 2. The frequency from the AFC loop. If, for example, the delta pseudo-range interval computation for a particular channel is zero, then it can be the AFC measurement, otherwise it is a delta pseudo-range computation

2.2.28 Test Mode Raw Tracking Loop Data – Message I.D.49

Output Rate: Every measurement cycle (full power / continuous: 8.33Hz)

Example:

```
?—Start Sequence and Payload Length
31010000000000015000660D0F3FBE95E417B235C—Payload
?—Message Checksum and End Sequence
```

Table 138: Test Mode Raw tracking Loop Data Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		31			49
nChannel	1		01			1
Reserved	4		00000000			0
Channel	1		00			0
Satellite ID	1		15			20
Receiver Time Tag	4		000660D0	ms		135000
Carrier Doppler Rate	4	100000	F3FBE95E 417B235C	Carrier Cycles/2ms/10 ms	104857	2.1016756638e+007
Carrier Doppler	4	100000	F3FBE95E 417B235C	Carrier Cycles/2ms	1048576	2.1016756638e+007
Carrier Phase	4	400	468C6964	Carrier Cycles	1024	1.6756767578e+004
Code Offset	4	181000	00009783	Chip	1576960	38787

Payload Length: variable

Table 139: Detailed Description of Test Mode Raw Tracking Loop Data Message

Name	Description
Message ID	Message I.D. number
nChannel	Number of channels reported
Reserved	Reserved
Channel	Receiver channel number for a given satellite being searched or tracked
Satellite ID	Satellite or Space Vehicle (SV) I.D. number or Pseudo-random noise (PRN) number
Receiver Time Tag	This is the count of ms interrupts from the start of the receiver (power on) until measurement sample is taken. Millisecond interrupts are generated by the receiver clock
Carrier Doppler Rate	The carrier Doppler rate value from the Costas tracking loop for the satellite ID on channel 0
Carrier Doppler	The frequency from the Costas loop for the satellite ID on channel 0
Carrier Phase	The carrier phase value from the Costas tracking loop for the satellite ID on channel 0
Code Offset	The code offset from the Code loop for the satellite ID on channel

2.2.29 SBAS Parameters – Message I.D. 50

Outputs SBAS operating parameter information including SBAS PRN, mode, timeout, timeout source, and SBAS health status.

Output Rate: Every measurement cycle (full power / continuous: 1Hz)

Example:

```
A0A2000D—Start Sequence and Payload Length
327A001200000000000000000000—Payload
BEBEB0B3—Message Checksum and End Sequence
```

Table 140: SBAS Parameters Message

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		32			50
SBAS PRN	1		7A			122
SBAS Mode	1		00			0
DGPS Timeout	1		12			18
Flag bits	1		00			0
Spare	8		000000000 0000000			00000000

Payload Length: 13 bytes

Table 141: Detailed Description of SBAS Parameters

Name	Description
Message ID	Message I.D. number
SBAS PRN	0 = Auto mode SBAS PRN 120-138= Exclusive
SBAS Mode	0 = Testing, 1 = Integrity Integrity mode will not accept SBAS corrections if the SBAS satellite is transmitting in a test mode. Testing mode will accept and use SBAS corrections even if the SBAS satellite is transmitting in a test mode
DGPS Timeout	Range: 1 –2 50 seconds. 0 returns to default timeout. The last received corrections will continue to be applied to the navigation solution for the timeout period. If the timeout period is exceeded before a new correction is received, no corrections will be applied
Flag bits	Bit 0: Timeout; 0 = Default 1 = User Bit 1: Health; Reserved Bit 2: Correction; Reserved Bit 3: SBAS PRN; 0 = Default 1 = User
Spare	Spare

2.2.30 PPS Time – Message I.D. 52

Outputs the time associated with the current 1 PPS pulse. Each message will be output within a few hundred ms after the 1 PPS pulse is output, and will tell the time of the pulse that just occurred. The SiRF binary message ID 52 will report the time of the 1 PPS pulse in UTC any time it has a current status message from the satellites. If it does not have a valid status message, it will report time in GPS time, and will so indicate by means of the status field.

Output Rate: 1Hz (Synchronized to PPS)

Example:

```
A0A2000034.—Start Sequence and Payload Length
15122A0E0A07D3000D000000050700000000—Payload
0190B0B3—Message Checksum and End Sequence
Payload Length: 19 bytes
```

Table 142: Timing Message Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		34			52
Hour	1		15			21
Minute	1		12			18
Second	1		2A			42
Day	1		0E			15
Month	8		0A			10
Year	2		07D3			2003
UTCOffsetInt	2		000D			13
UTCOffsetFrac	4	10^9	00000005	ns	10^9	5
Status	1		7			7
Reserved	4		00000000			00000000

Note: The status byte is bit-mapped with the following meaning:

Bit Fields	Meaning
[0]	When set, bit indicates that time is valid
[1]	When set, bit indicates that UTC time is reported in this message. Otherwise it is GPS time
[2]	When set, bit indicates that UTC to GPS time information is current, i.e. IONO/UTC time is less than 2 weeks old
[3-7]	Reserved

2.2.31 Extended Measured Navigation – Message I.D. 98

In contrast to the NMEA protocol, SiRF binary protocol by default only outputs the position information in a cartesian coordinate frame called Earth-Centered, Earth-Fixed (ECEF). For many applications geodetic-mapping coordinates of Latitude, Longitude and Altitude, similar to NMEA, are desired. In the SiRF binary protocol time is sent as GPS week number and Time of Week (TOW). But in many applications, the universal time coordinated (UTC) is the best time format.
Output Rate: 1 Hz
Table 143 lists the binary and ASCII message data format for the extended measured navigation data.

Example:

```
A0A20027 -- Start Sequence and Payload Length
6204EDBB4F00E3C83E0007C298000000FA0000006607FB9FB9
6407CF091E0712B0C20B06090507 -- Payload
0C73B0B3 -- Message Checksum and End Sequence
```

Table 143: Extended Measured Navigation

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		62			98
Latitude	4	$*10^8$	04Edbb4f	rad	$/10^8$	0.82688847
Longitude	4	$*10^8$	00e3c83e	rad	$/10^8$	0.14927934
Altitude	4	*1000	0007C298	m	/1000	508.568
Speed over Ground	4	*1000	000000FA	m/s	/1000	0.250
Climb Rate	4	*1000	00000066	m/s	/1000	0.102
Course over Ground	4	$*10^8$	07FB9FB9	rad	$/10^8$	1.33930937
Mode	1		64	Bitmap[58]		100[59]
UTC Year	2		07CF	years		1999
UTC Month	1		09	months		9
UTC Day	1		1E	days		30
UTC Hour	1		07	hr		7
UTC Minute	1		12	min		18
UTC Second	2	*1000	B0C2	s	/1000	45.250
GDOP (geometric DOP)	1	*5	0B		/5	2.2
PDOP (horizontal DOP)	1	*5	06		/5	1.2
HDOP (position DOP)	1	*5	09		/5	1.8
VDOP (vertical DOP)	1	*5	05		/5	1.0
TDOP (time DOP)	1	*5	07		/5	1.4

Payload Length: 39 bytes

58 Table 144 lists the meaning of the individual bits

59 >/= 4 Satellite Solution (3D), validated, UTC leap seconds corrected

Table 144: Mode Bitmap

Mode	Hex	ASCII	Description
Bit 0…2	0x00	0	No navigation solution
	0x01	1	1 Satellite solution[60]
	0x02	2	2 Satellite solution[61]
	0x03	3	3 Satellite solution (2D)[62]
	0x04	4	≥ 4 Satellite solution (3D)
	0x05	5	2D Point solution (Krause)
	0x06	6	3D Point solution (Krause)
	0x07	7	Dead Reckoning
Bit 3	0x08	8	Dead reckoning timed out
Bit 4	0x10	16	DOP mask exceeded
Bit 5	0x20	32	Fix quality (1 = validated, 0 = unvalidated)
Bit 6	0x40	64	UTC (1 = leap seconds corrected, 0 = not corrected)
Bit 7	0x80	128	DGPS (1 = used, 0 = unused)

2.2.32 Development Data – Message I.D. 255

Output Rate: Receiver generated

Example:

```
A0A2.... — Start Sequence and Payload Length
FF.... — Payload
....B0B3 — Message Checksum and End Sequence
```

Table 145: Development Data

Name	Bytes	Binary (Hex)		Unit	ASCII (Decimal)	
		Scale	Example		Scale	Example
Message ID	1		FF			255

Payload Length: variable

Note: MID 255 is output when SiRF Binary is selected and development data is enabled. The data output using MID 255 is essential for SiRF assisted troubleshooting support.

60 Altitude hold, direction hold and time hold

61 Altitude hold and direction or time hold

62 Altitude hold

2.3 Additional Information

2.3.1 Trickle Power Operation in DGPS Mode

When in Trickle Power Mode, serial port DGPS corrections are supported. The CPU goes into sleep mode but will wake up in response to any interrupt. This includes UARTs. Messages received during the Trickle Power 'off' period are buffered and processed when the receiver awakens for the next Trickle Power cycle.

2.3.2 GPS Week Reporting

Since August 22nd, 1999, the GPS week roll from 1023 weeks to 0 weeks is in accordance with the ICD-GPS-200 specifications. To maintain roll over compliance, SiRF reports the ICD GPS week between 0 and 1023. If the user needs to have access to the Extended GPS week (ICD GPS week + 1024) this information is available through the Clock Status Message (007) under the Poll menu.

2.3.3 NMEA Protocol in Trickle Power Mode

The NMEA standard is generally used in continuous update mode at some predefined rate. This mode is perfectly compatible with all SiRF Trickle Power and Push-to-Fix modes of operations. There is *no* mechanism in NMEA that indicates to a host application when the receiver is on or in standby mode. If the receiver is in standby mode (chip set OFF, CPU in standby), then no serial communication is possible for output of NMEA data or receiving SiRF proprietary NMEA input commands. To establish reliable communication, the user must repower the receiver and send commands while the receiver is in full-power mode (during start-up) and prior to reverting to Trickle Power operation. Alternatively, the host application could send commands (i.e., poll for position) repeatedly until the request has been completed. The capability to create communication synchronization messages in NMEA mode is available through the System Development Kit (SDK), refer to www.sirf.com for further details.

In Trickle-Power Mode, the user is required to select an update rate (seconds between data output) and On Time (milliseconds the chip set is on). When the user changes to NMEA mode, the option to set the output rate for each of the selected NMEA messages is also required. These values are multiplied by the Trickle Power update rate value as shown in Table 146.

Table 146: NMEA Data Rates Under Trickle Power Operation

Power Mode	Continuous	Trickle Power	Trickle Power	Trickle Power
Update Rate	1 every second	1 every second	1 every 5 seconds	1 every 8 seconds
On Time	1000	200	400	600
NMEA Update Rate	1 every second	1 every 5 seconds	1 every 2 seconds	1 every 5 seconds
Message Output Rate	1 every second	1 every 5 seconds	1 every 10 seconds	1 every 40 seconds

Note: The On Time of the chip set has no effect on the output data rates.